AFCRL-62-494 (II)
OCTOBER 1962

401 651

Air Force Surveys in Geophysics
No. 141

Research Report

ATLAS OF MONTHLY MEAN STRATOSPHERE CHARTS, 1955-1959
PART II, JULY-DECEMBER

H. STUART MUENCH
THOMAS R. BORDEN, JR.

METEOROLOGICAL RESEARCH LABORATORY - PROJECT 8604
AIR FORCE CAMBRIDGE RESEARCH LABORATORIES, OFFICE OF AEROSPACE RESEARCH
UNITED STATES AIR FORCE, BEDFORD MASSACHUSETTS

ATLAS OF MONTHLY MEAN STRATOSPHERE CHARTS, 1955-1959. PART II, JULY-DECEMBER

ABSTRACT

This volume is the second of two depicting average conditions in the stratosphere over the northern hemisphere during the period July 1955 to July 1959. Monthly mean charts of contours and isotherms are presented for the 100-mb, 50-mb, and 25-mb levels for each of the 48 months. In addition, four-year composite means are presented for each of the twelve months of the year at each level. The maps clearly show how the monthly mean pattern for a winter month can vary considerably from year to year, whereas the patterns for the summer m ths vary but little from year to year.

INTRODUCTION

There are several ways to describe the circulation patterns of the stratosphere as they are observed, and during recent years many subjective and objective descriptions have been prepared, each with a slightly different purpose. One of the first comprehensive graphic descriptions was done by Kochanski (1955) who presented data in the form of midseasonal cross sections. Wege (1957, 1958) presented a series of monthly mean northern hemisphere charts at 100 mb and 50 mb, based on data from 1949 to 1953. Wege showed, among other features, substantial longitudinal variations in the circulation patterns, even when five years of data were averaged. A report by Wege and others (1958) presented seasonal mean charts at levels from 30 mb to 15 mb along with seasonal cross sections at several longitudes. More recently, a group directed by S. Teweles under the U.S. Weather Bureau (1960, 1961) has been publishing a series of daily charts at 100 and 50 mb during the IGY. In addition, daily charts for the 100, 50, and 25 (or 30) mb level have been published by Scherhag (1960) for the past several years, based on teletype data.

Graphic descriptions of the stratosphere have both uses and limitations and none is suitable for all purposes, nor answers all questions. The Atlas contained herein sets no precedent along these lines. The justification for the creation of this Atlas is that it presents better answers to some questions and uses more recent data than many of the other studies. Thus the purpose is twofold — to present recent data in a summarized form and to answer certain questions on the reliability of normal charts based on a few years of data.

The method of summarizing the data was simply to construct monthly mean charts for four years at the 100-mb, 50-mb, and 25-mb levels. A four-year period was chosen because data summaries were available from 1955 through 1959, and indicated something of the difference in behavior of the circulation from one year to the next. Also, it was found to be convenient to use graphical averaging in obtaining overall means for each month, and it is easier to graphically average four rather than three or five. The data might have been summarized in the form of daily charts as the USWB group is doing for the IGY, but this is an exhausting task in terms of plotting, analyzing, drafting, and reproduction. On the other hand, seasonal charts or charts of midseasonal months hide much of the variation of one year from another. As a compromise, the data are summarized in the form of monthly mean charts. The one-month period is not unique, and if the wind and temperature spectra were investigated (Chiu, 1960) a meteorologically more significant time period might be found (the author prefers 15-day periods for the stratosphere, especially during fall, winter, and spring), but the one-month period is compatible with previous studies by Wege and with monthly mean charts at 500 mb published by the long-range forecast group of the USWB.

DATA SOURCES

Ideally, for a study of this sort there should be a comprehensive network of stations with sufficient compatible radiosonde observations to permit reliable computations of mean temperature, mean pressure-height, and mean vector wind. With limited time, funds and manpower, however, many compromises had to be made with regard to data, and it is hoped that such compromises did not seriously affect the accuracy of the charts.

To avoid needless duplication, summaries of previously computed monthly mean data were assembled and tabulated:

1. Climatalogical Data, National Summary, USWB, Asheville, N.C., July 1955 - June 1959.
2. Monthly Climatic Data for the World, USWB, Asheville, N.C., September 1956 - June 1959 (no data above 150-mb level prior to September 1956; none above 100-mb level after September 1956).
3. Mean Monthly Upper Tropospheric Circulation Over the Tropical Pacific During 1954 - 1959, Joint Task Force Seven, Meteorological Center, University of Hawaii, Vols. 1, 2 and 4.
4. Aerological Data of Japan, Japan Meteorological Agency, Tokyo, Japan, July 1955 - September 1959.

Data were extracted from the original charts used to prepare "Monthly mean 50-mb and 100-mb Charts Preceding the IGY" by Hans A. Panofsky, Pennsylvania State University, University Park, Penn., Final Report, Part III, AF19 (604)-2190.

A special summary, "Mean Upper Air Data and Statistics for Northern Hemisphere, 50- and 25-mb Levels, July 1958 to December 1959," was prepared for this project by the Data Processing Division, Climatic Center, AWS, Asheville, N.C.

Even with all these summaries, it was still necessary to compute additional monthly mean data to fill in regions of sparse data, and for this purpose the following data sources were used:

1. Daily series, Synoptic Weather Maps, Part II, Northern Hemisphere Data Tabulations, USWB, July 1955 - June 1959.
2. Summary of Constant Pressure Data, WBAN Form 33, National Weather Records Center, Asheville, N.C.
3. IGY Microcards, Form 3 (Radiosonde and Rawinsonde Observations) and Form 4 (Upper Wind Observations), WMO/OMM Geneva, Switzerland.

An extensive series of monthly mean data was received from Massachusetts Institute of Technology covering the period July to December 1957. The data was a by-product of a general circulation project underway at M.I.T. under the direction of Victor P. Starr.

DATA PROCESSING AND PLOTTING

Analysts working with radiosonde data at levels of 100 mb or higher over the northern hemisphere are plagued with problems of errors in the data. The random day-to-day errors become greatly smoothed by time averaging of the data and the RMSE (root-mean-square error) of the mean of 25 observations would be but 20 percent of the RMSE of a single observation (assuming a normal distribution of errors). Since the RMSE's or noise level of United States radiosonde data at 50 mb appear to be about 53 meters in pressure height, 1° to $2^{\circ}C$ in temperature and 8 to 10 knots in wind (Muench; Hering), and foreign data do not appear to be too much worse, then the mean value of a month of data should be reasonably accurate so that horizontal smoothing, using a vast number of stations, is not necessary.

A second source of error in the data, that due to incompatibility between different sondes and different times of ascent, is not affected by averaging and remains to annoy the analyst. The groups at Pennsylvania State University and the USWB worked up elaborate schemes to correct for incompatibility. Unfortunately, some of the summarized data sources are not clear as to the type of instrument used, any corrections used, or even the time or rate of ascent. The simplest approach to this problem was found to be the use of only nighttime pressure-height and temperature data,

and winds from either observation. Apparently, most of the incompatibility among different instruments is due to solar radiation heating of improperly ventilated temperature elements, and this source of error is lacking at night. There still remained problems because some stations took only daytime soundings; other stations, because of their location, sent up soundings in daytime at both observation periods during the spring and summer season; and there was some incompatibility among different types of sondes even at night. These problems were approached in the analysis stage by subjectively modifying or ignoring certain data and relying heavily on mean vector winds and data from U.S. radiosonde instruments abroad.

In the process of computing additional mean data to fill in regions of sparse data, the number of observations necessary to compute a reasonable mean was noted, since it was a bit difficult to work with some of the raw data. The usual procedure is to average all of the observations. The day-to-day temperature changes in the stratosphere, however, are nearly always small compared to changes over periods of weeks or months, so that daily observations are not really very independent. This means that only a few observations are necessary to obtain a representative value, and more observations would be useful only to reduce the inherent random error.

As an example of how few observations are necessary to produce reasonable mean heights and temperature, a month with great variation in temperature and height was selected. In January 1958, the data for 00Z at 100 mb at Thule, Greenland were tabulated, and mean heights and temperatures were computed with different numbers of observations equally spaced throughout the month. The height and temperature data are shown in Fig. 1. The averages, using different numbers of observations, are shown in Table 1, and the error, or difference from the mean of 31 observations, is shown in Fig. 2 as a function of the number of observations. (The approximate RMSE's of a single observation are indicated on the margins.) It should be noted that the observation for 25 January was missing and data for that date were estimated by linear interpolation between data from the 24th and 26th.

Obviously from this example, which represents a case of extremely great variability, a relatively small number of evenly spaced observations, as few as eight or ten, will produce very satisfactory means. This is not too surprising, considering that the USWB computes means of daily temperatures based on only two points, the maximum and minimum temperature. With stratosphere data, however, it is desirable to reduce both sampling bias and effects of errors in individual observations, so it seems necessary to use at least eight days per month, while more than fifteen is superfluous. In practice it was found convenient to use ten observations, since division of the summation is so simple.

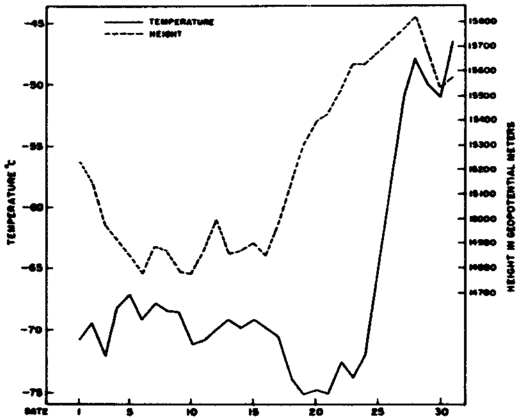


FIG. 1. Daily 100 mb 00Z temperature and height at Thule, Greenland, January 1958.

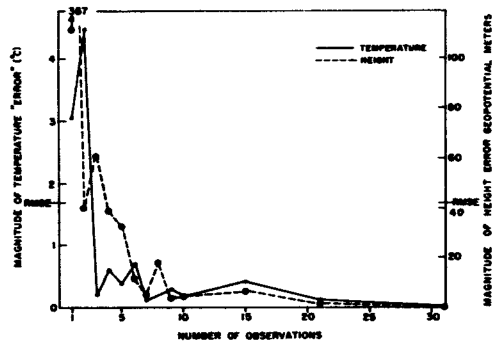


FIG. 2. Magnitude of "error" of means computed from evenly spaced observations.

Looking at the curves of height and temperature in Fig. 1, one may easily see how strongly biased means might arise if even five or ten days of observations, bunched in either the first or second half of the month, were missing. And considering that monthly means of data from high latitude stations are often made from fifteen or fewer observations, sampling bias could easily be a problem especially in mean data that are already summarized. In many cases five evenly spaced observations will produce a better mean than ten or fifteen nonevenly spaced observations. In practice, efforts were made to use temporal or vertical extrapolation to fill in missing observations and insure against sampling bias when means were computed by this group. Published means were checked and corrections made when necessary if there were indications that sampling bias might be present. For this reason differences will be found between some of the maps in this study and those published by Pennsylvania State University, particularly those on high latitudes during winter months. In general, the data were processed so as to reduce errors due to instrumentation and to sampling, and it is hoped that the results were better than might be obtained from blindly analyzing unprocessed data.

TABLE 1. Mean heights and temperatures by using different numbers of observations.

Number	Mean Height, Meters	Mean Temperature, °C
1	14,849	-69.9
2	15,246	-71.1
3	15,144	-66.9
4	15,245	-66.1
5	15,173	-67.1
6	15,218	-67.4
7	15,211	-66.8
8	15,188	-66.9
9	15,202	-67.0
10	15,211	-66.9
15	15,200	-67.1
21	15,204	-66.6
31	15,206	-66.7

ANALYSIS

The analysis procedure was rather straightforward, though admittedly subjective. The flow patterns as indicated by mean winds were quite simple with only a few troughs and ridges, and there was little difficulty in drawing smooth contours consistent with the accuracy of the data. For the most part, the winds were assumed to be geostrophic at least south to 10° north latitude. There were some indications of small systematic ageostrophic components in the entrances and exits of strong wind maximums, but the magnitude of these components was probably less than five knots. The contour analyses were continued right down to the equator where the winds were, of course, not geostrophic; but streamlines were entered in low latitudes to indicate at least the direction of the flow.

As mentioned previously, four-year means computed graphically for each month and each level are included. Since a large part of the variance in the wind at low latitudes is contained in a period or oscillation of 24 to 27 months (Reed et al.; Veryard and Ebdon) and there is little amplitude in a twelve-month period, there seemed no point in analyzing the four-year means below 15° north latitude.

RESULTS

The charts for 100 mb, 50 mb, and 25 mb for July through December are presented, assembled in order of month, level and year. The four-year means are also included. The contour spacing is for every 100 meters of height from July through September and for every 200 meters of height* from October through December. The contours are labelled in tens of meters on charts from July through September (four digits) and in hundreds of meters from October through December (three digits). The temperature spacing is for every 10°C at 100 mb and for every 5°C at 50 mb and 25 mb. Intermediate contours and isotherms have been added to better define temperature and contour patterns. Customary H and L symbols have been added. At times, several H's are present along a ridge line even though there is little evidence of separate centers, in order to emphasize the direction of the gradient. Temperature maxima and minima have been designated by W for warm and C for cold.

The maps quantitatively demonstrate features that were previously known qualitatively. The average circulation patterns of some months appear to be quite similar from one year to the next, notably July through October and to some extent November. Thus the four-year mean for these months should be representative and useful. The patterns of December vary considerably from year to year, particularly in high latitudes, and as an extreme, at 25 mb there is a difference in pressure-height gradients of more than 750 meters between the mean pressure-height gradients for December of 1957 and December of 1958. This probably indicates that the four-year mean for this month is not a very good estimate of the long-term mean (say the twenty-year mean) and also that a long-term mean would not be very useful as an estimate of the average circulation pattern for the month of December much less as an estimate of the daily circulation pattern.

At 50 mb and 25 mb, the biennial equatorial wind oscillation, investigated by Reed and by Veryard and Ebdon, clearly shows east winds one year switching to westerlies the following year and returning to easterlies the third year. There was good evidence that at 100 mb both easterlies and westerlies were often present in the means at the same time but at different longitudes around the equator. There is still much to be explained of equatorial circulation patterns, particularly in the stratosphere.

The four-year means compared quite closely to those obtained by Wege from 1949 to 1953 data. In general, the heights for this four-year period were slightly lower than those found in Wege's study, both in high and low latitudes, and it is not known whether this is real or because this author used only nighttime heights and temperature data. The contour patterns on Wege's maps do appear slightly less zonal south of 25° latitude than on these charts. Otherwise the patterns appear similar, and heights, temperatures and winds derived from one set would no doubt be similar to values derived from the other.

Perhaps after another couple of years, a similar study will be made using data from July 1959 through June 1963 and the results of the new study, this study and Wege's study combined to produce a fairly reliable set of monthly normal charts for the stratosphere. It would also be nice to have maps of standard deviations of wind, temperature, and height about individual monthly means. This Atlas gives information on how the individual monthly mean circulations differed from the four-year mean and indicates to some extent the usefulness of the four-year mean in specifying the circulation for any one month. Information of the extent to which any monthly mean chart can be used to specify the circulation for any individual day would be desirable, and standard deviations would certainly be useful for this purpose.

TABULATION OF MEAN WIND, MEAN HEIGHT AND MEAN TEMPERATURE

Although the form of presentation in the Atlas is considered appropriate from a meteorological point of view, it may not be desirable for general engineering use. Therefore, immediately following the charts, some of the information is presented in tabulated form. These tables contain values of the mean wind, mean height, and mean temperature taken from the graphically averaged four-year mean charts for each of the mid-seasonal months.

The geostrophic wind approximation was used to obtain mean vector winds from the analyzed geopotential fields. Mean winds and interpolated values of height and temperature are given for 10° latitude intervals for latitudes 20°N through 80°N and at 30° longitude intervals around the hemisphere. In addition, mean values of height and temperature are presented for the North Pole.

In the tables the mean vector wind directions (DD) are rounded to the nearest 10°; and the velocities (VV) are rounded to the nearest 5 knots when the extracted value was less than 30 knots, and to the nearest 10 knots when the extracted value was over 30 knots. If the extracted velocity was less than 3 knots, a 00 code is entered in the table under VV. In the case of a calm, both DD and VV are coded as 00. Perhaps it should be emphasized at this point that the direction is the direction from which the wind is blowing. The mean heights are tabulated in 10's of geopotential meters* and the mean temperatures to the nearest degree (Centigrade).

*By meteorological convention, units of geopotential meters are merely geometric meters multiplied by local values of the acceleration of gravity (g) and then divided by 9.8 so that geopotential meters are actually units of specific energy and not of geometric height. However, the geopotential meter has been defined so that specific energy in these units is numerically very close to geometric height in meters. For example, at the equator the geometric height would be two-tenths of a percent higher than the geopotential height, while at the North Pole it would be three-tenths of a percent lower.

Contents of the Tables

Tables 1A, 2A, 3A, and 4A show values of the mean vector wind at 100 mb, 50 mb, and 25 mb for the months of January, April, July, and October, respectively.

Tables 1B, 2B, 3B, and 4B show values of the mean height at 100 mb, 50 mb, and 25 mb for the months of January, April, July, and October, respectively.

Tables 1C, 2C, 3C, and 4C show values of the mean temperature at 100 mb, 50 mb, and 25 mb for the months of January, April, July, and October, respectively.

REFERENCES

1. Belmont, A. D. (1960) The Reversal of Stratospheric Winds Over North America, Scientific Report No. 1, AF19(604)-6618, AFCRC-GRD-TN-490.

2. Borden, T. R. (1960) The Wind Field at 100,000 Feet, During 1957 and 1958, Section IV, Contributions to Stratospheric Meteorology, GRD Research Notes No. 1, AFCRL 60-689, Vol. II.

3. Chiu, Wan-cheng (1960) The Wind and Temperature Spectra of the Upper Troposphere and Lower Stratosphere Over North America, Journal of Meteorology, 17:64-77.

4. Hering, Wayne S. (1960) Assessment of the Wind Forecasting Problem in the Stratosphere, Section VI, Contributions to Stratospheric Meteorology, GRD Research Notes No. 1, AFCRL 60-689, Vol. II.

5. Julian, P. R. (1959) Tropospheric Behavior Associated with the Arctic Warming Phenomenon, Final Report, Part I, AF19(604)-2190, AFCRC-TR-60-240 (I).

6. Kochanski, A. (1955) Cross sections of the mean zonal flow and temperature along 80° W. J. Met. 12:No. 2, 95-106.

7. Muench, H. S. (1958) Analysis of Synoptic Charts in the Stratosphere, Contributions to Stratospheric Meteorology, GRD Research Notes No. 1, AFCRC-TN-58-450.

8. Reed, R. J., Campbell, W. J., Rasmussen, L. A. and Rogers, D. G. (1961) Evidence of a Downward-Propagating, Annual Wind Reversal in the Equatorial Stratosphere, Journal of Geophysical Research, 66:No. 3, 813-818.

9. Scherhag, R. (1960) Berliner Wetterkarte, Institute für Meteorologie and Geofysik der Freien Universität Berlin, Vol. 9.

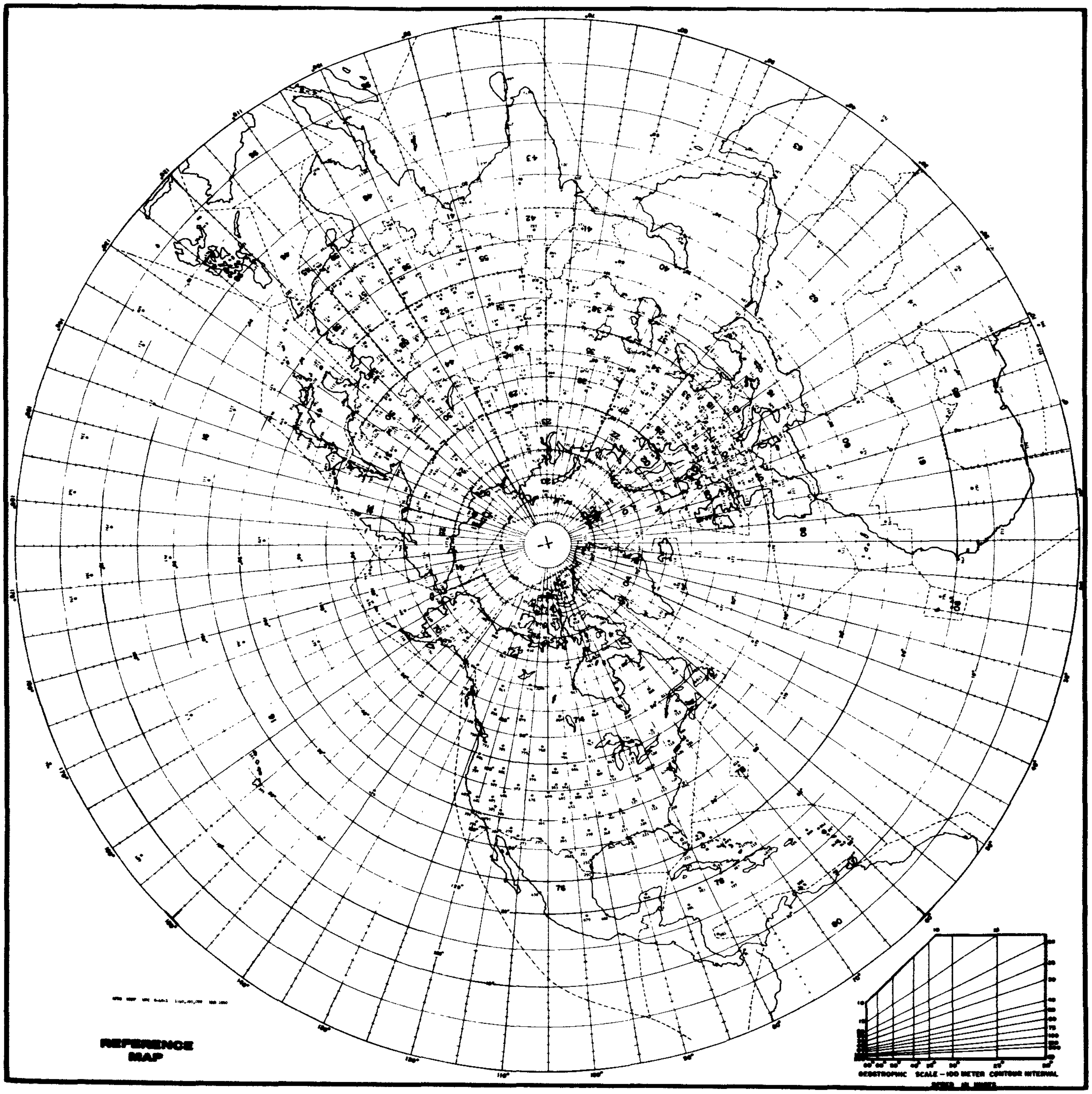
10. U. S. Weather Bureau (1960, 1961) Daily 100 Millibar, 50-Millibar and Three Times Monthly 30-Millibar Synoptic Weather Maps of the IGY Period.

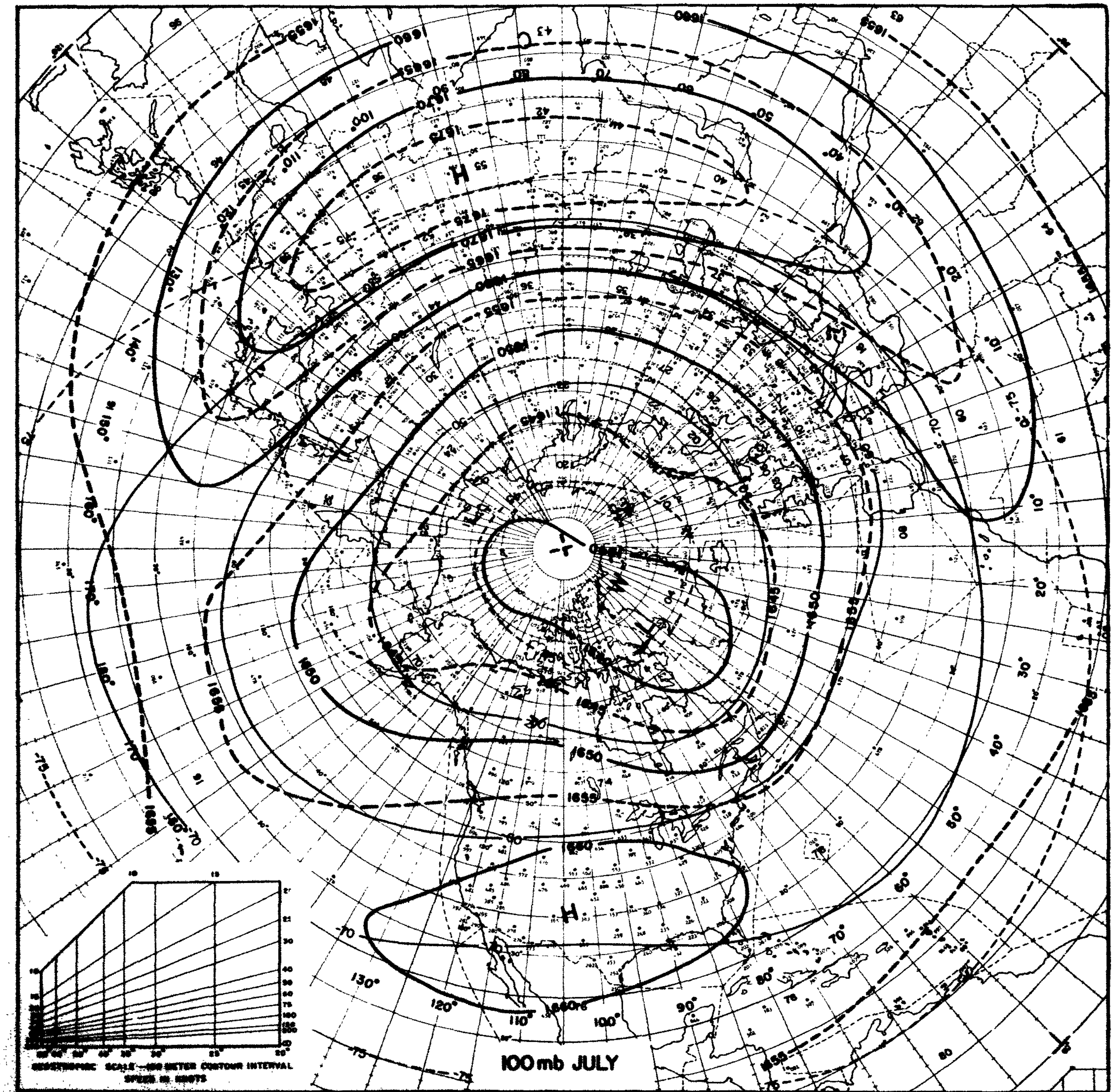
11. Veryard, R. G. and Ebdon, R. A. (1961) Fluctuations in Tropical Stratosphere Winds, Meteorological Magazine, 90:125-143.

12. Wege, K. (1957) Druck-Temperatur und Strömungsverhaltnisse in der Stratosphäre über der Nordhalbkugel, Meteorologische Abhandlungen, Band V, Heft 4.

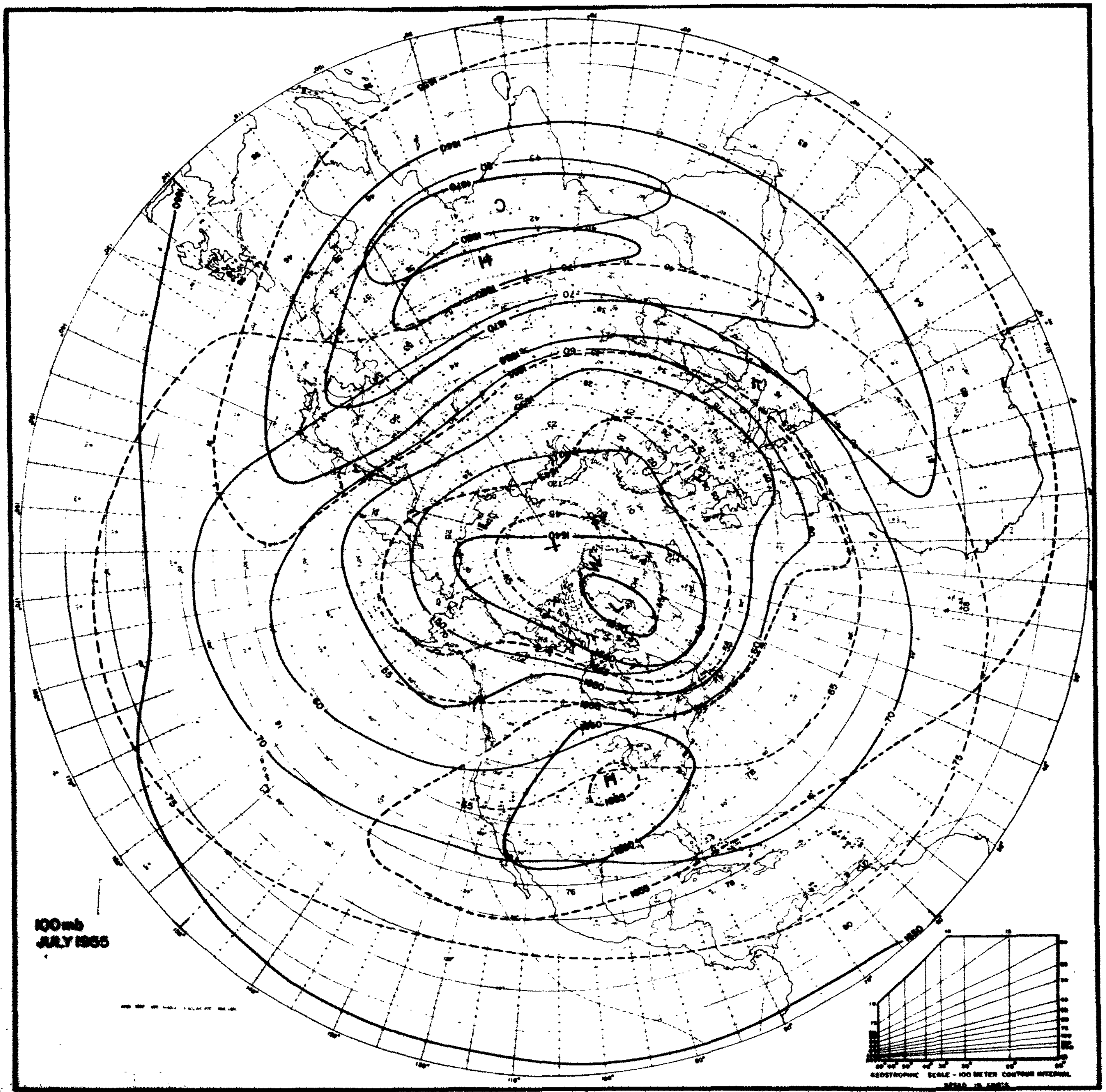
13. Wege, K. (1958) Druck-und Temperaturverhaltnisse der stratosphäre über der Nordhalbkugel in der Monaten März, Mai, September, November and December, Meteorologische Abhandlungen, Band VII, Heft 1.

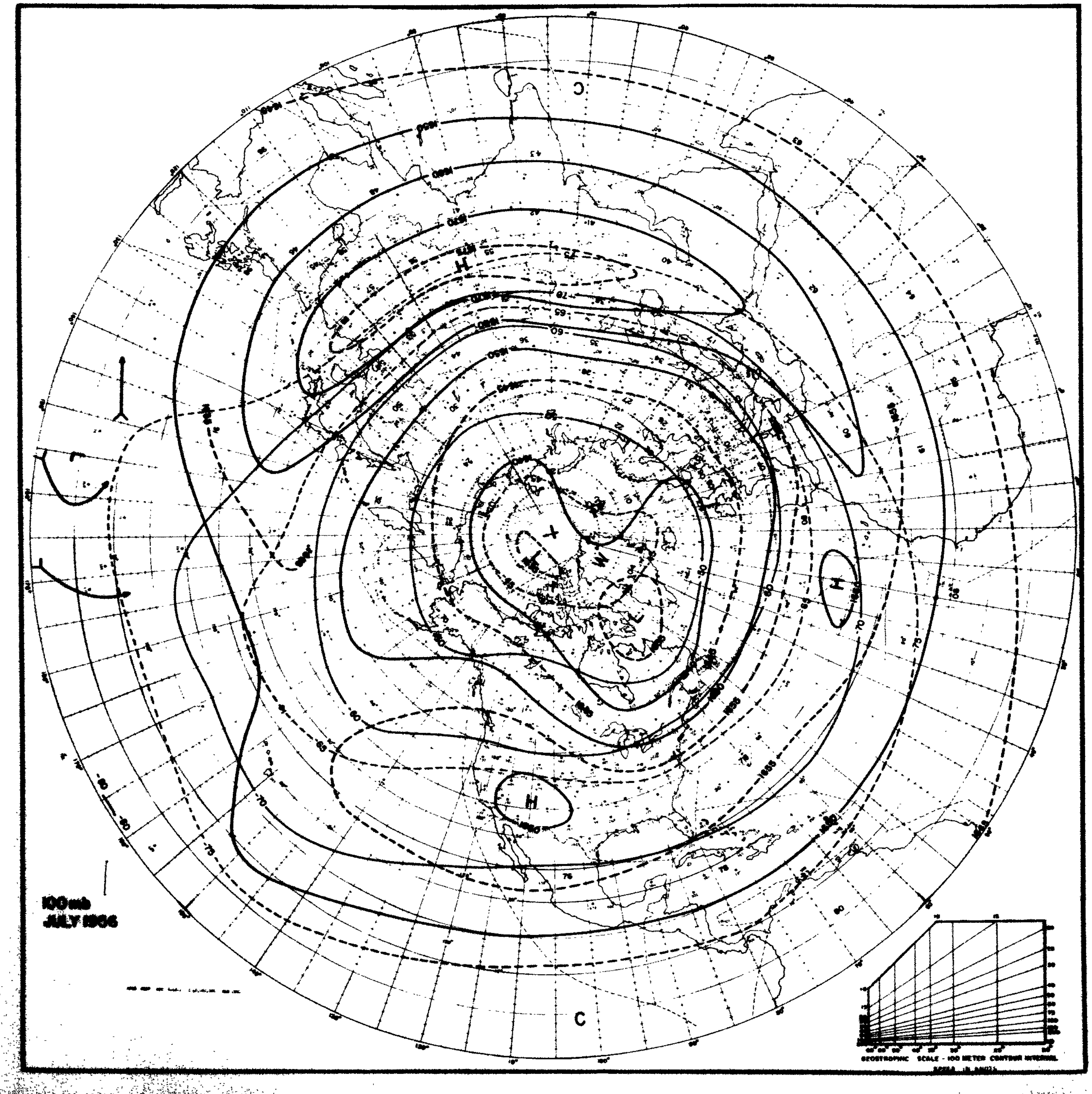
14. Wege, K., Leese, H., Groening, H. U. and Hoffman, G. (1958) Mean Seasonal Conditions of the Atmosphere at Altitudes of 20 km to 30 km and Cross Sections Along Selected Meridians in the Northern Hemisphere, Meteorologische Abhandlungen, Band VI, Heft 4.

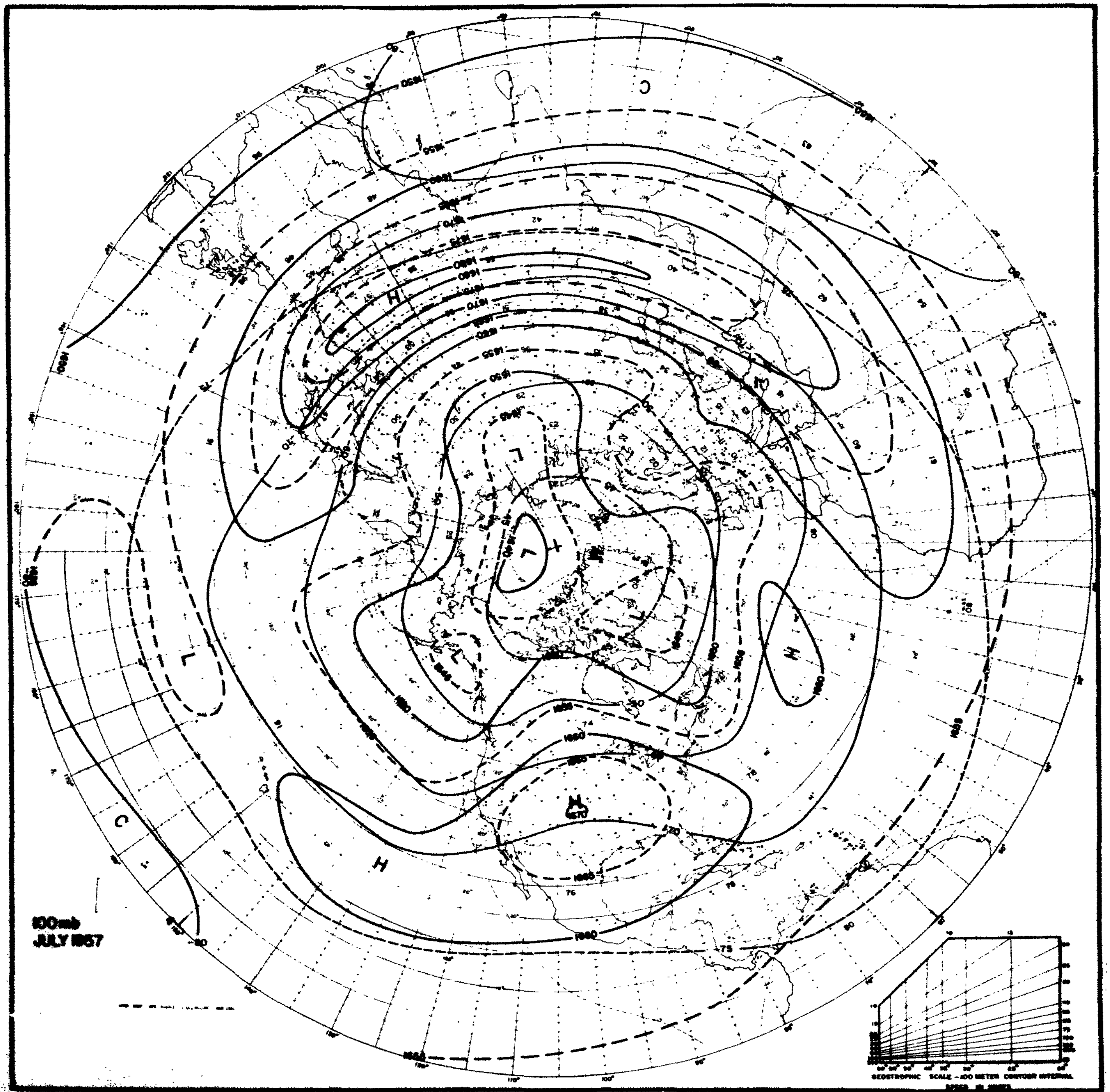

REFERENCE
MAP
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

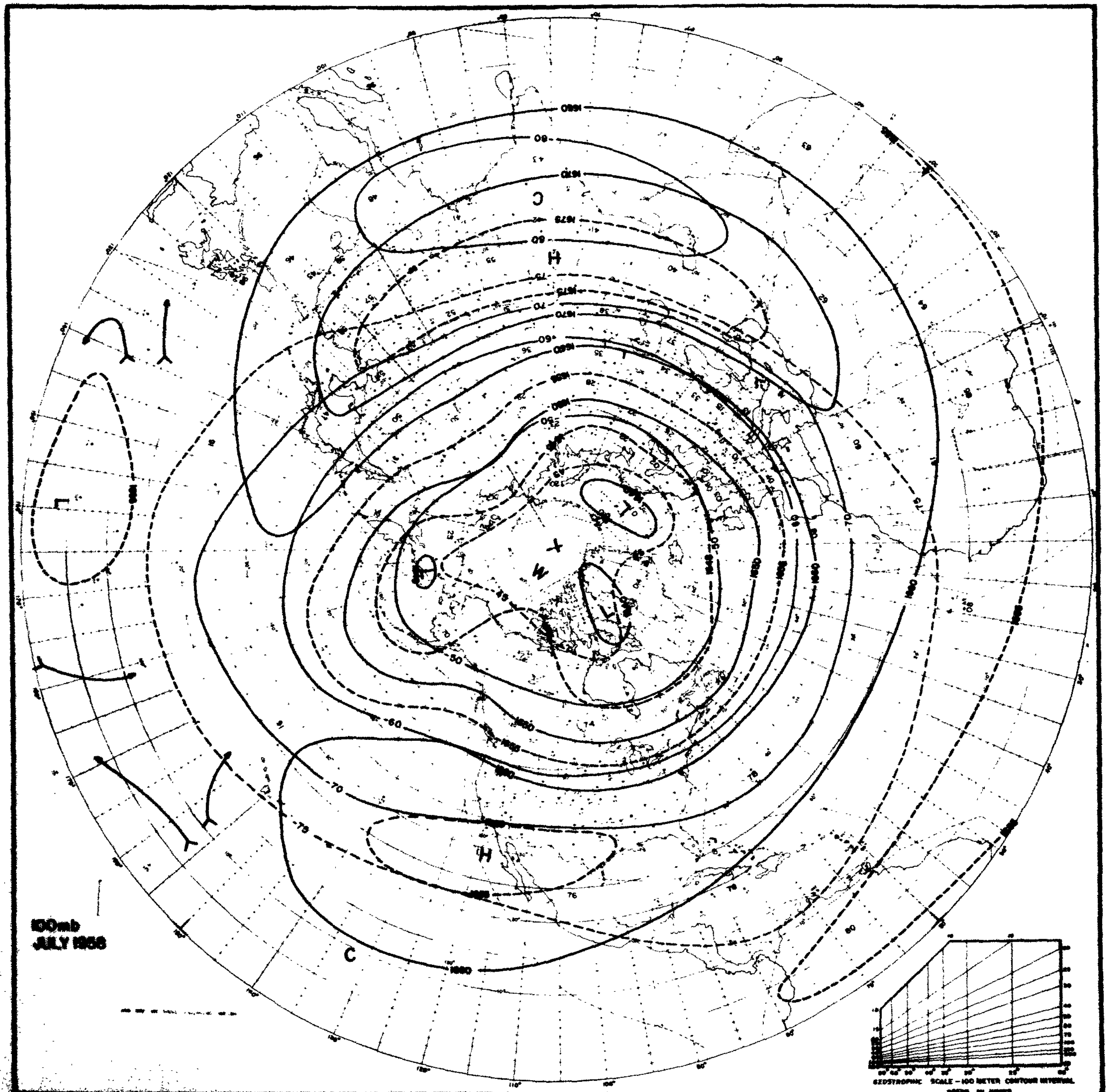


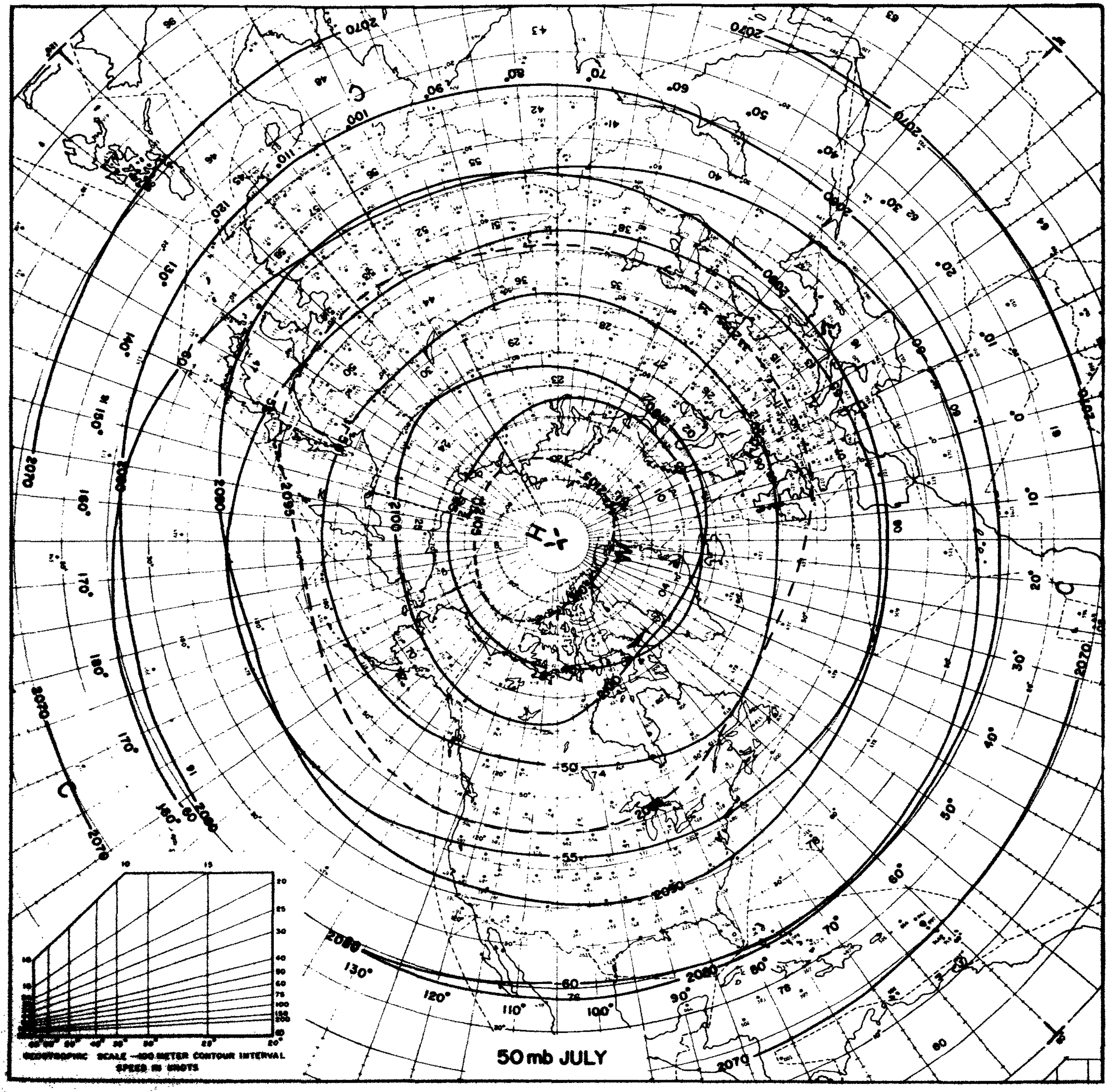
100mb JULY
GEOSTROPHIC SCALE — 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

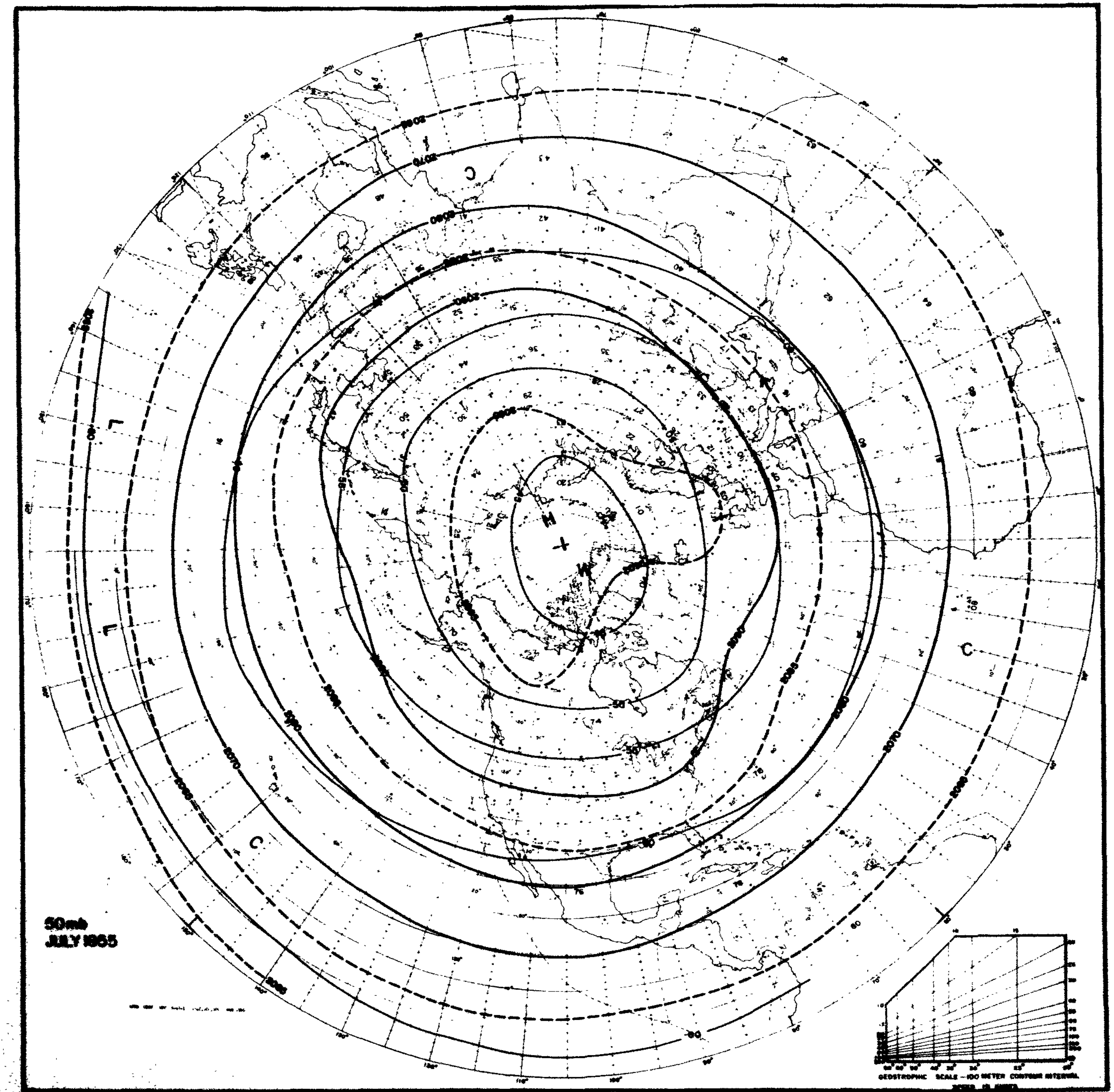

100 mb
JULY 1955
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS


100 mb
JULY 1966
C
C
H
H
H
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

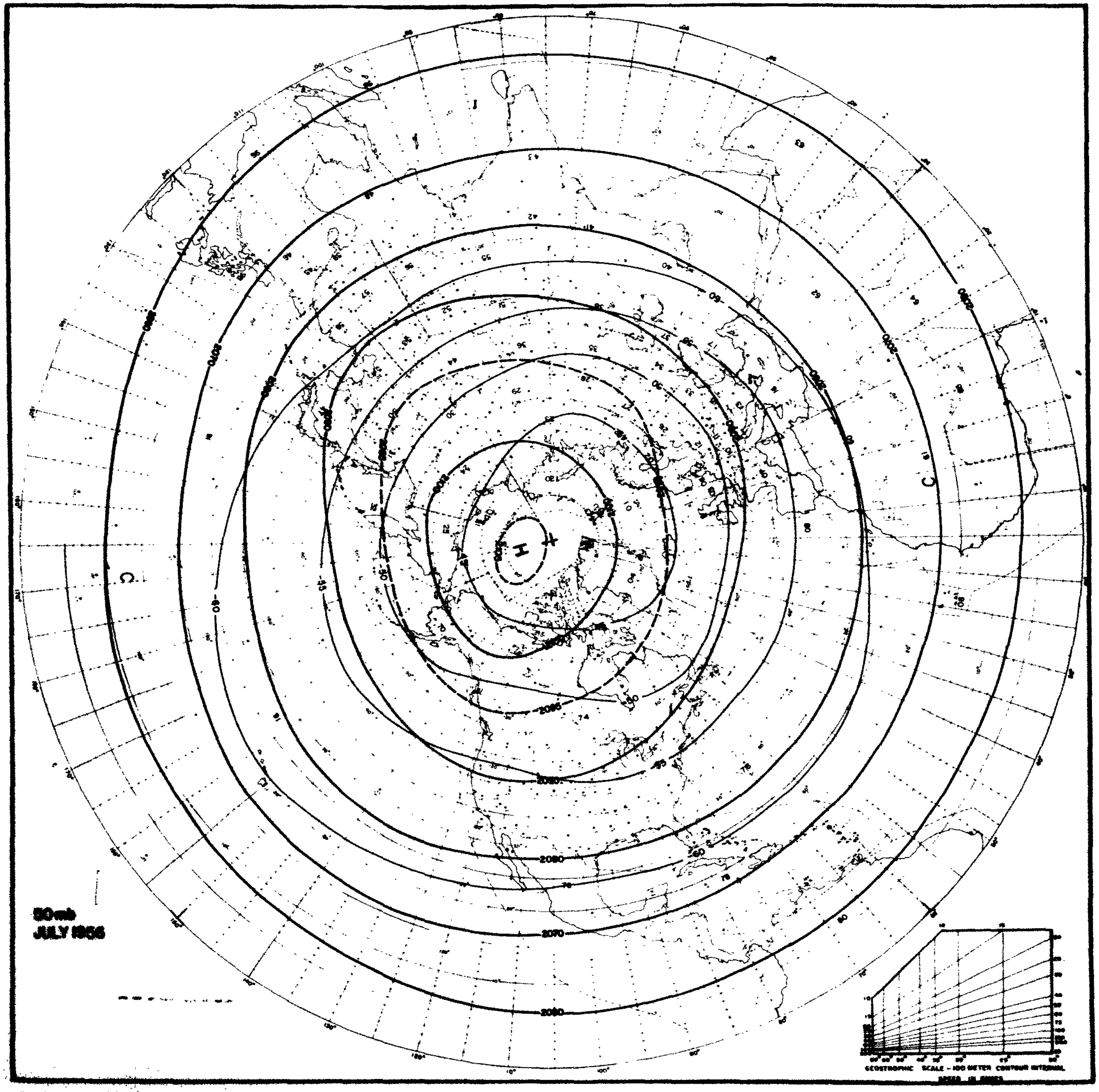

100mb
JULY 1967
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL


100mb
JULY 1958
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

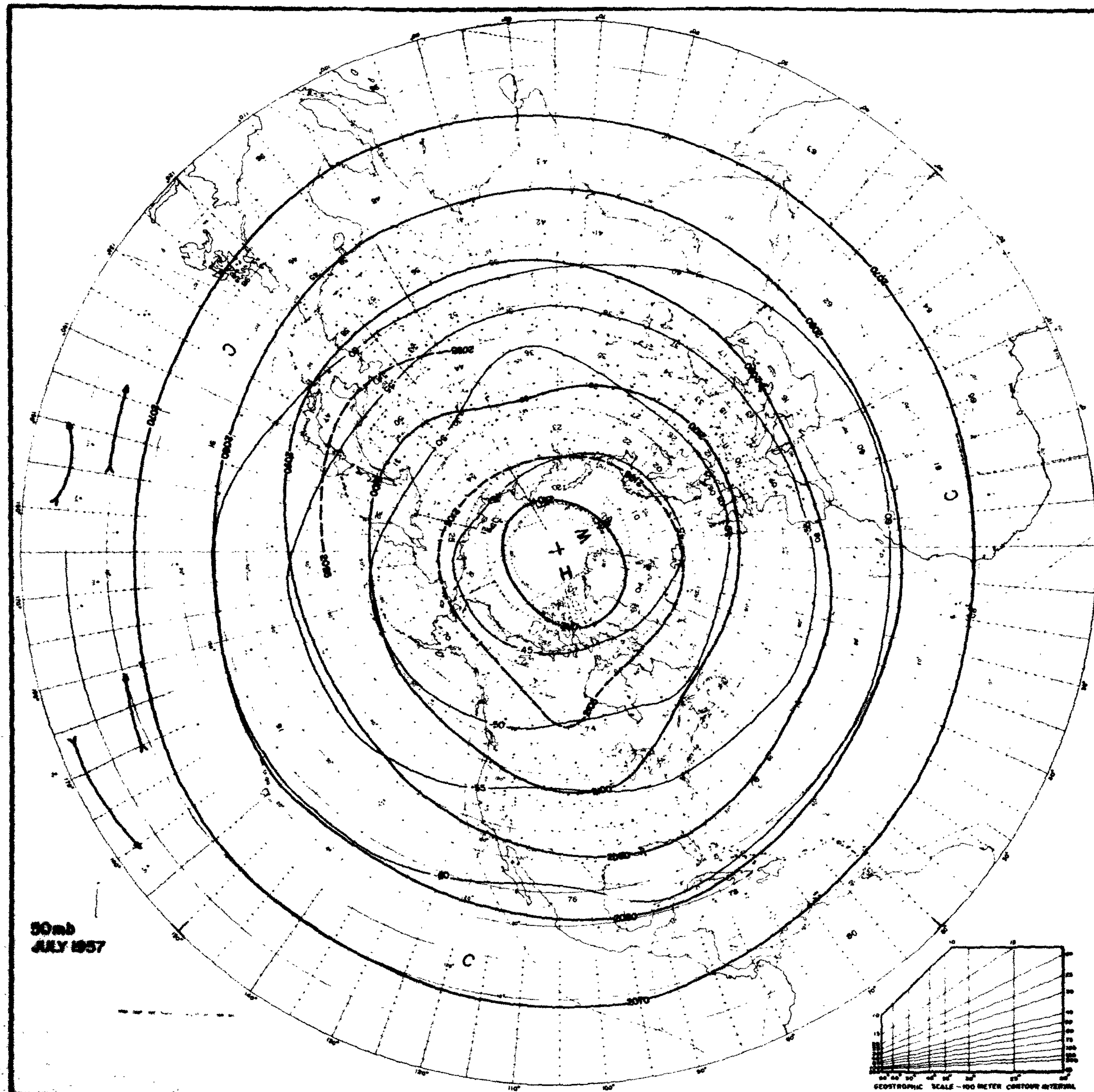

50 mb JULY
GEOSTROPHIC SCALE —100 METER CONTOUR INTERVAL
SPEED IN KNOTS

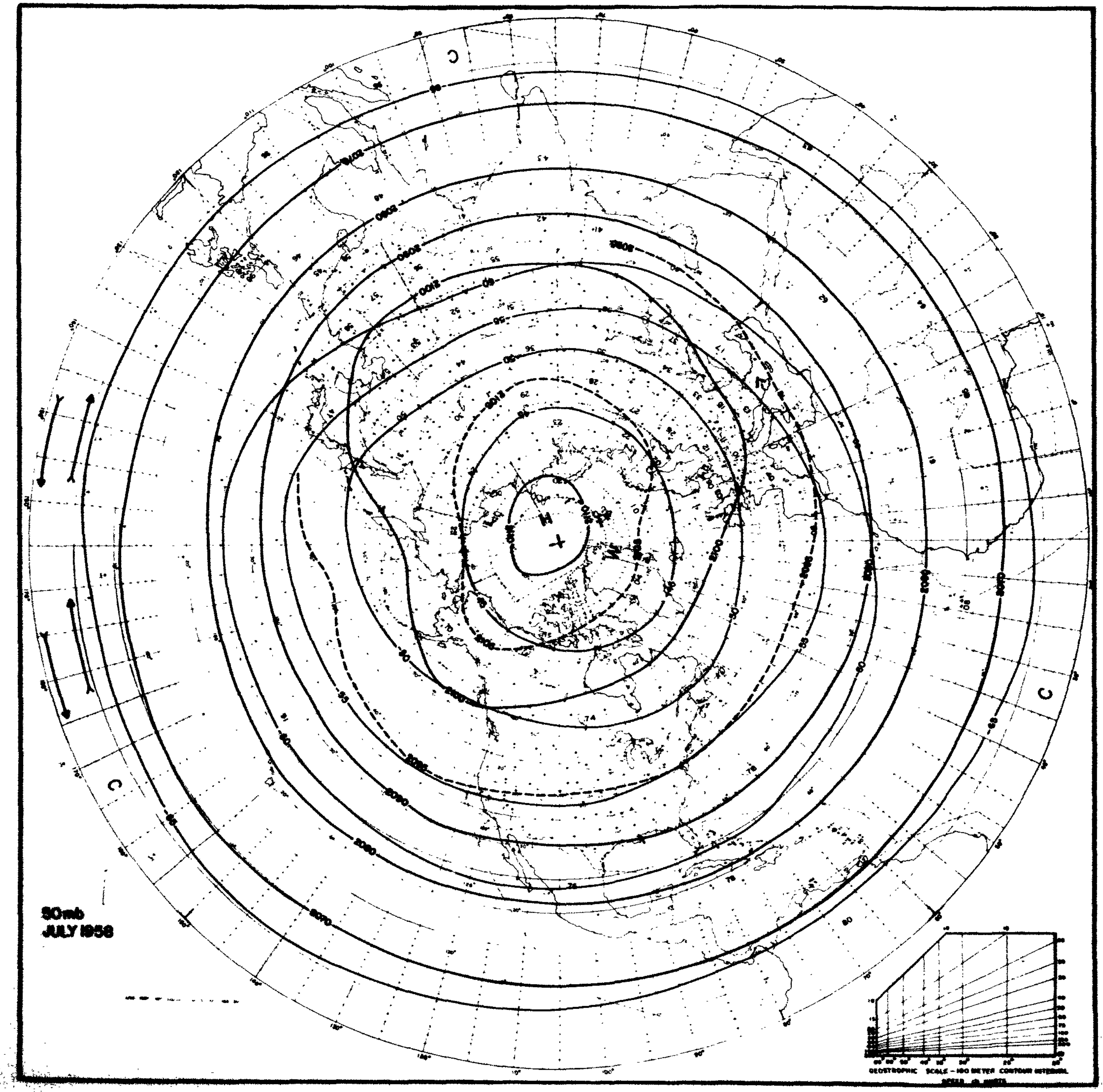


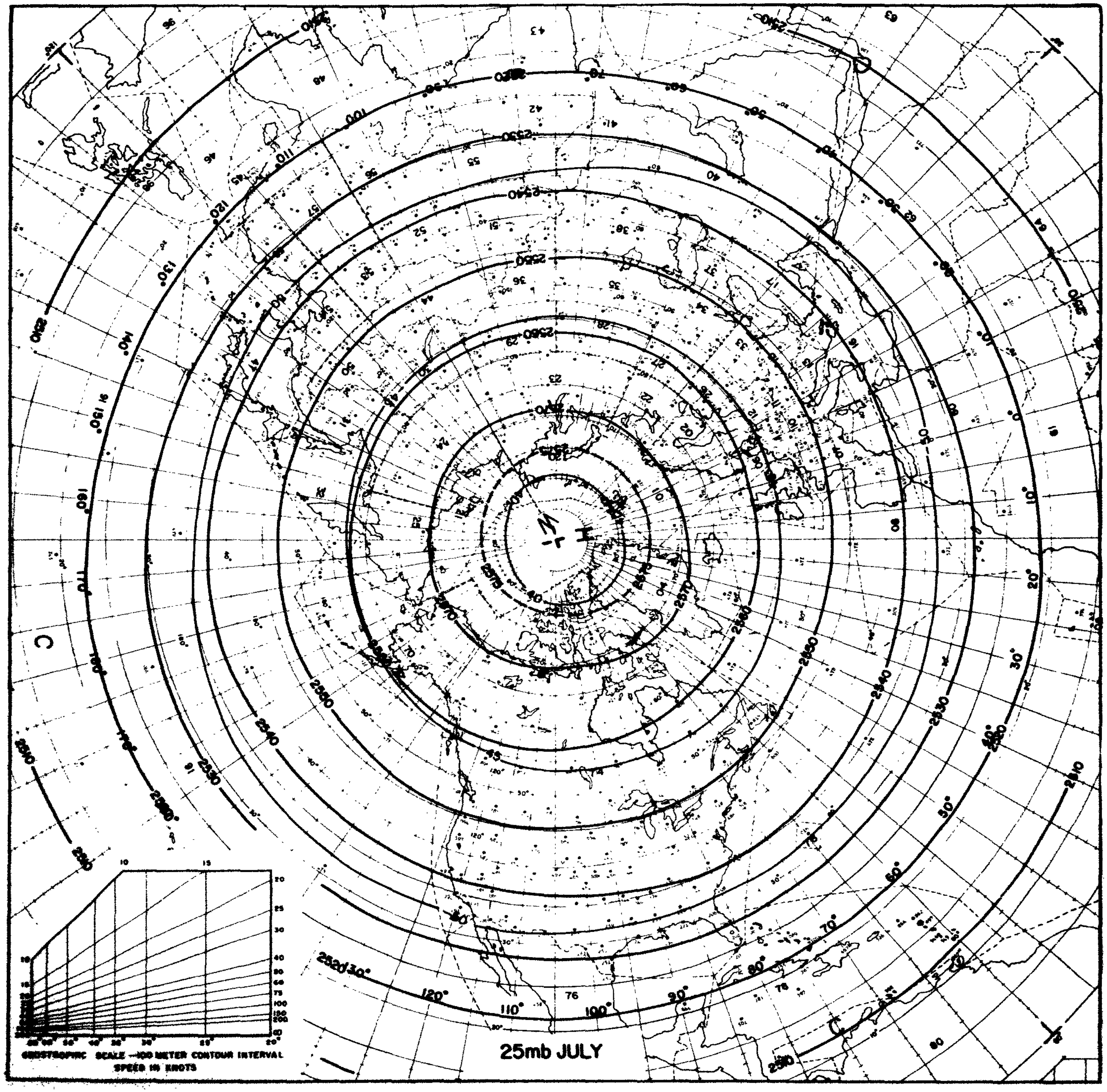
50mb
JULY 1965
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

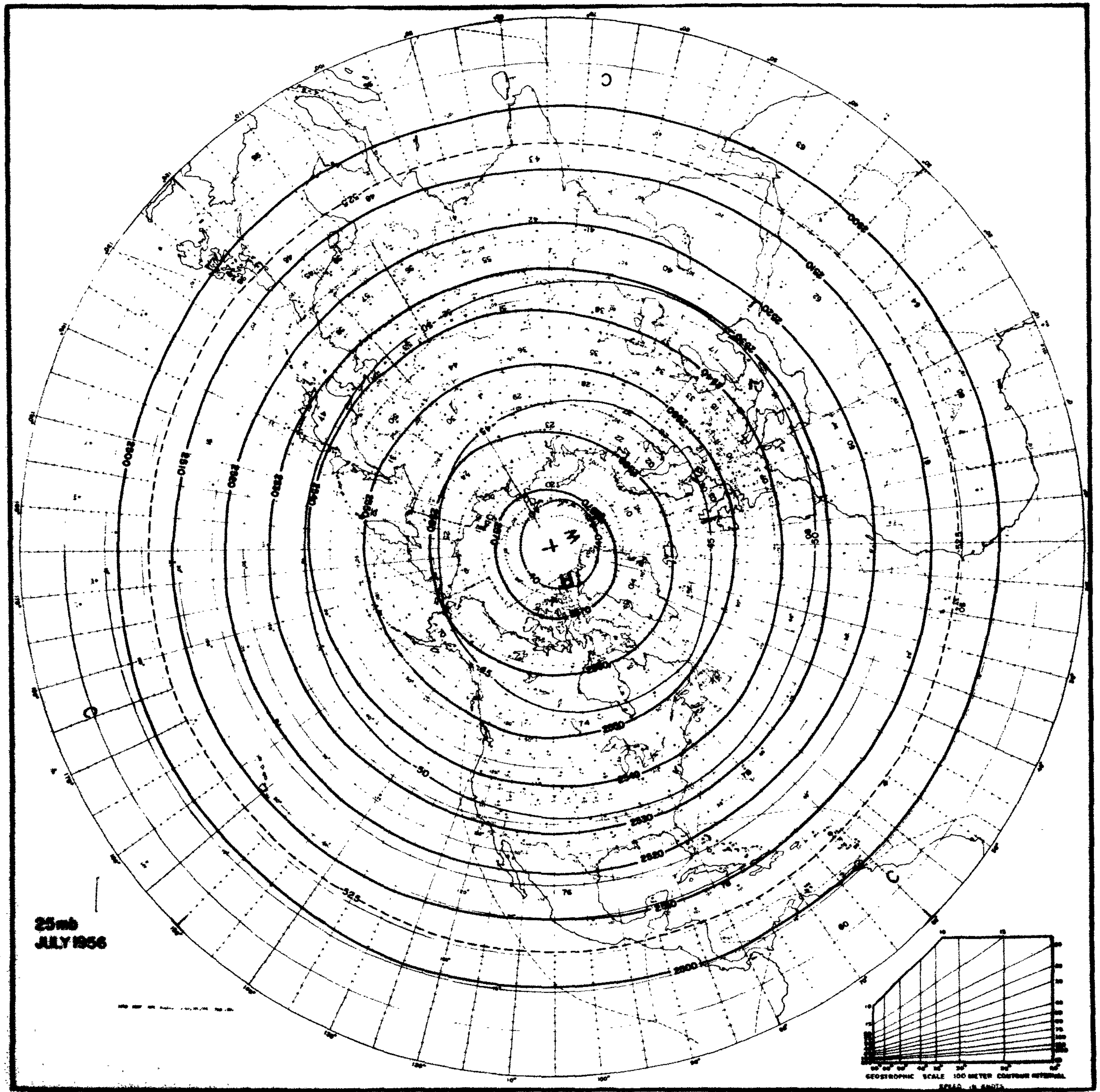


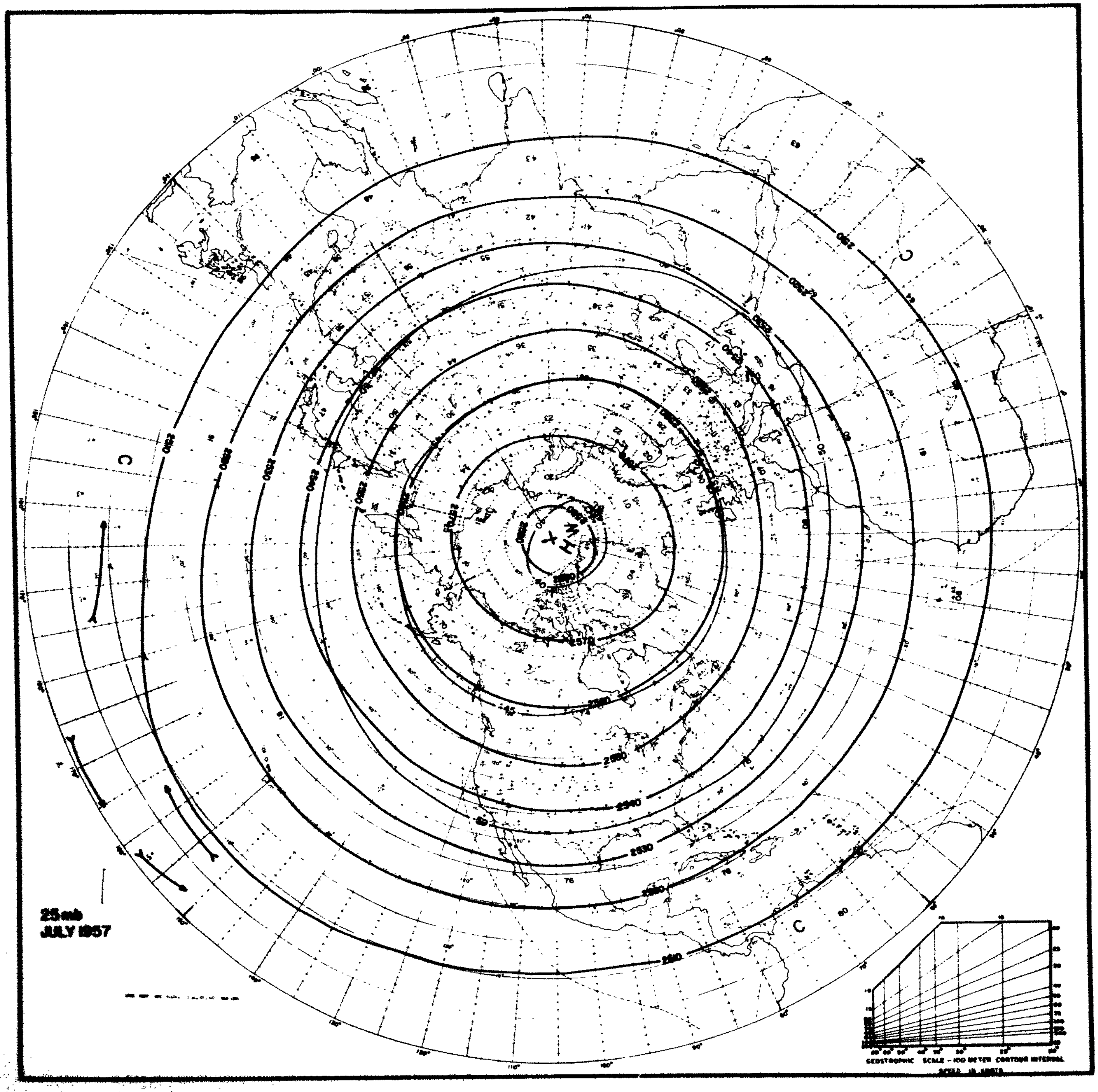
50 mb
JULY 1956
2080
2070
2080
H
C
C
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL


50mb
JULY 1957
H
W
C
C
C
2070
2080
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

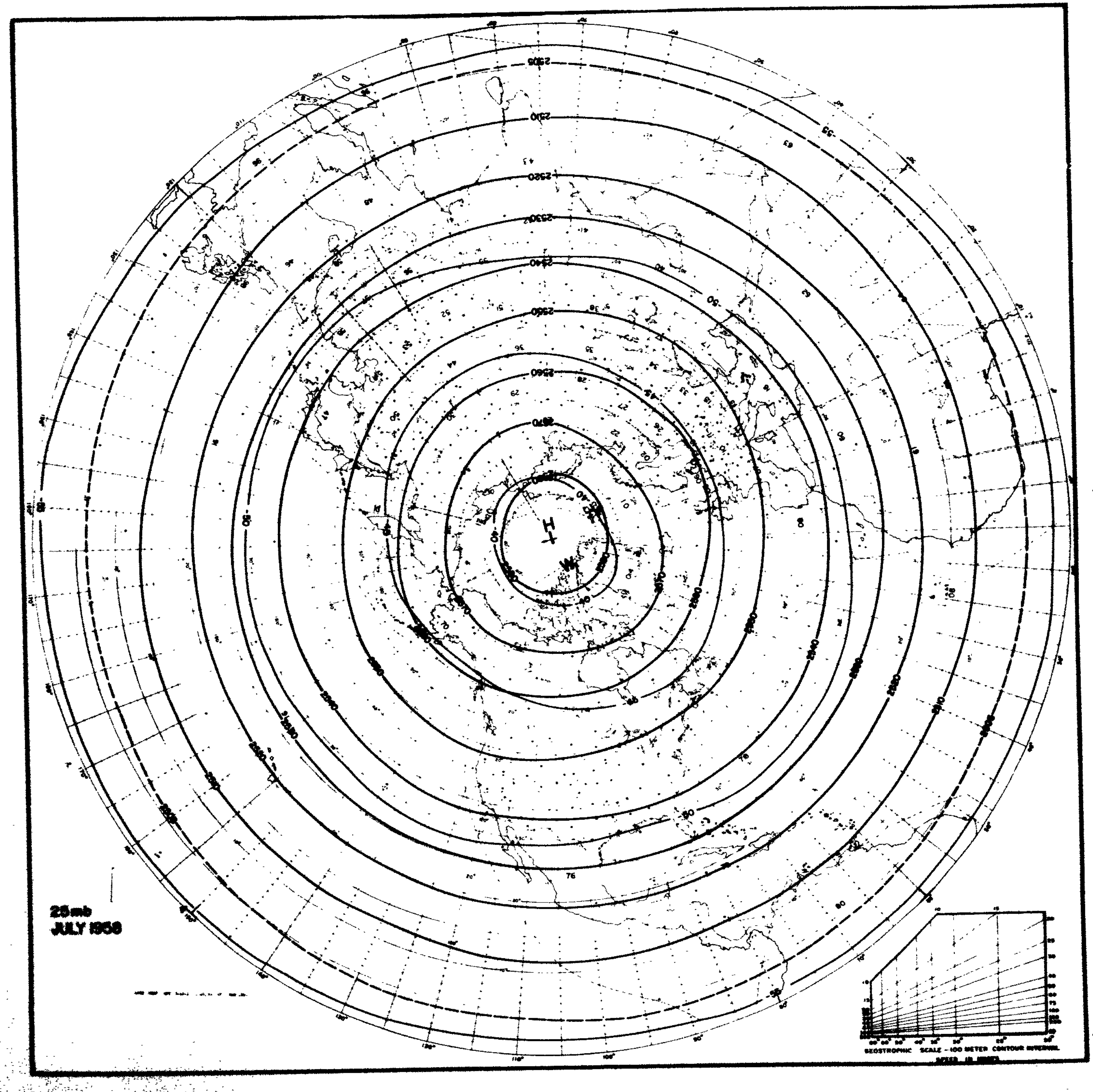

50mb
JULY 1958
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL


25mb JULY
GEOSTROPHIC SCALE —100 METER CONTOUR INTERVAL
SPEED IN KNOTS

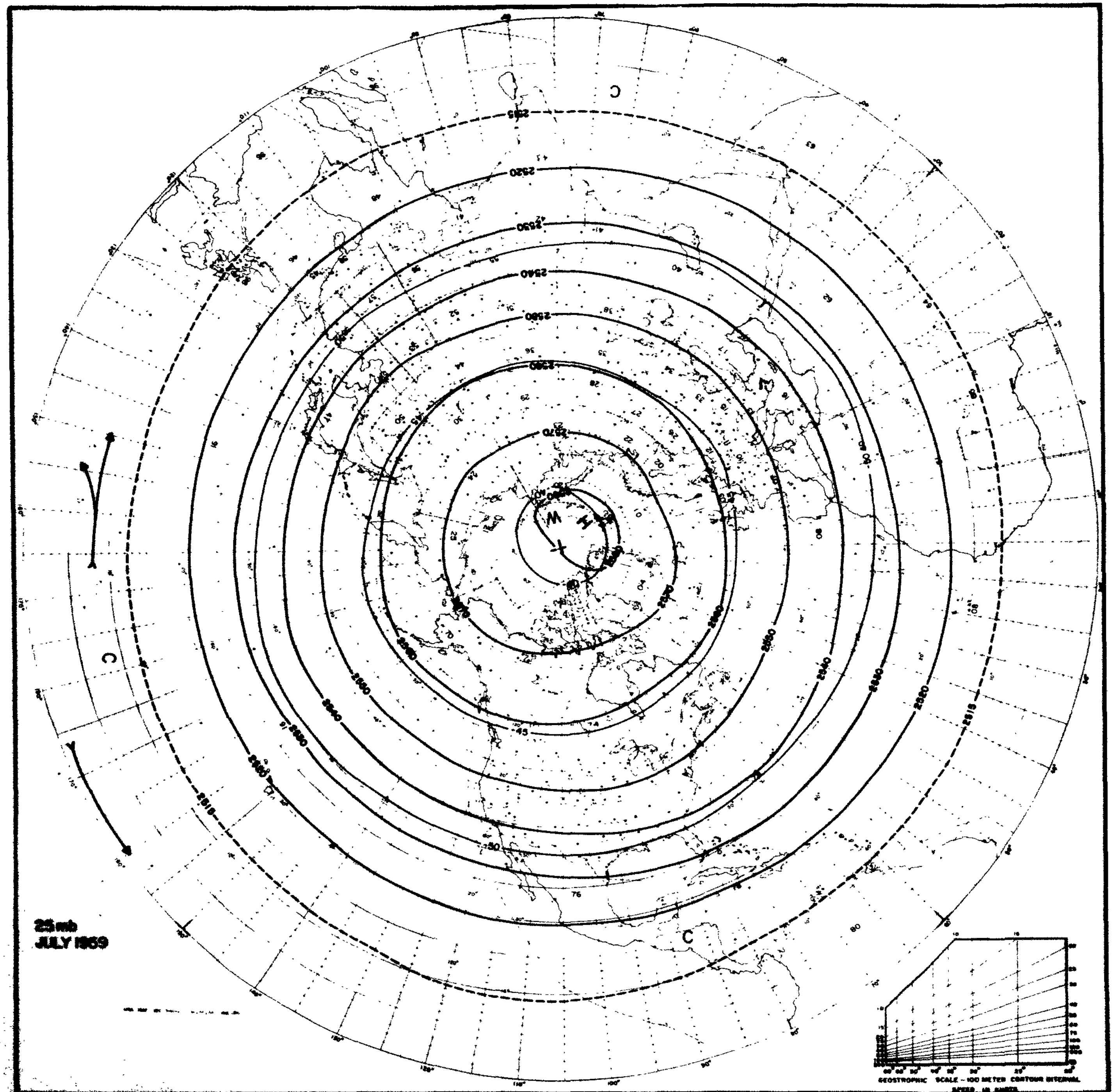

25 mb
JULY 1956
GEOSTROPHIC SCALE 100 METER CONTOUR INTERVAL
2900
2910
2920
2930
2940
2950
2960
2970
W
C

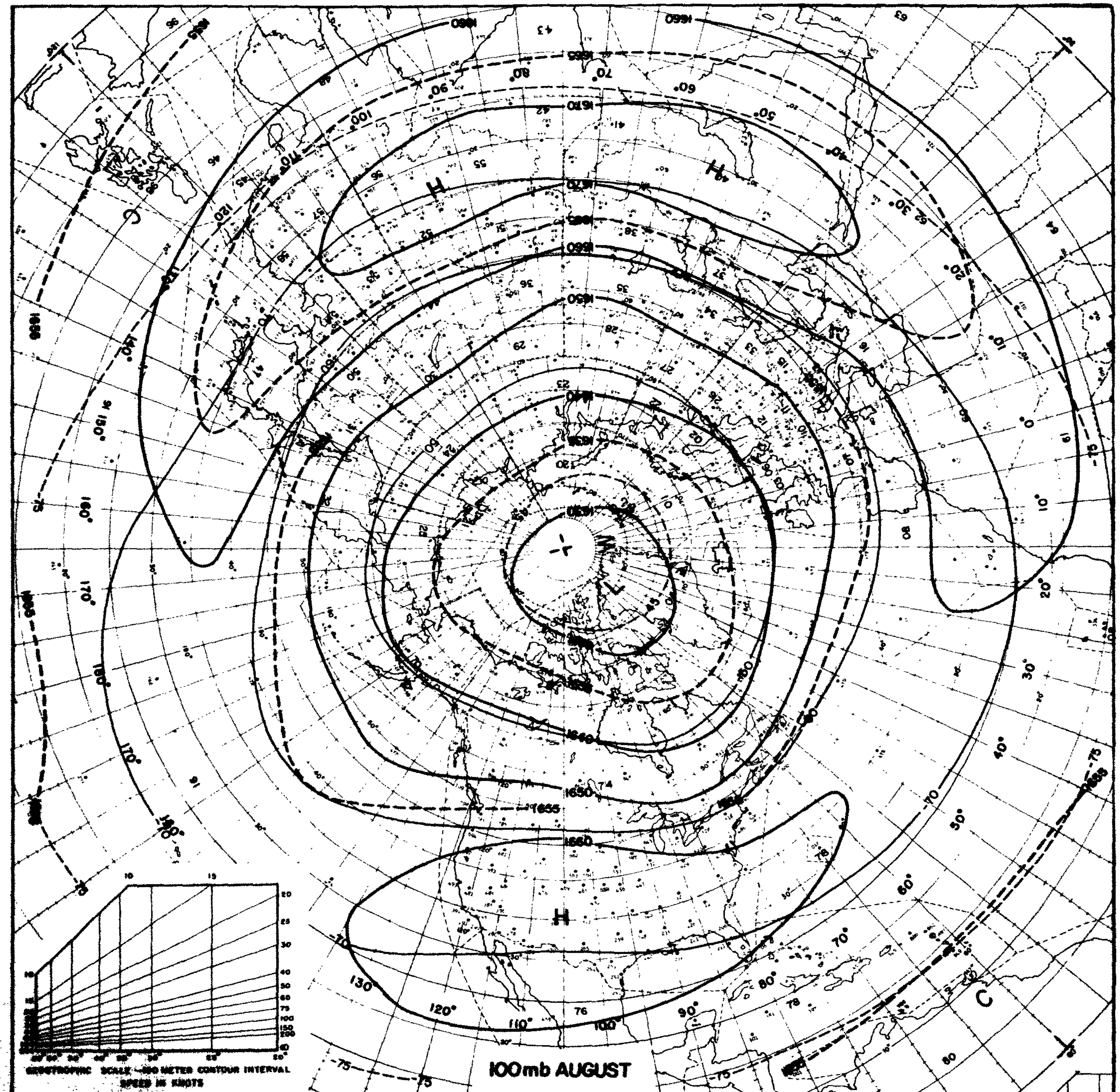


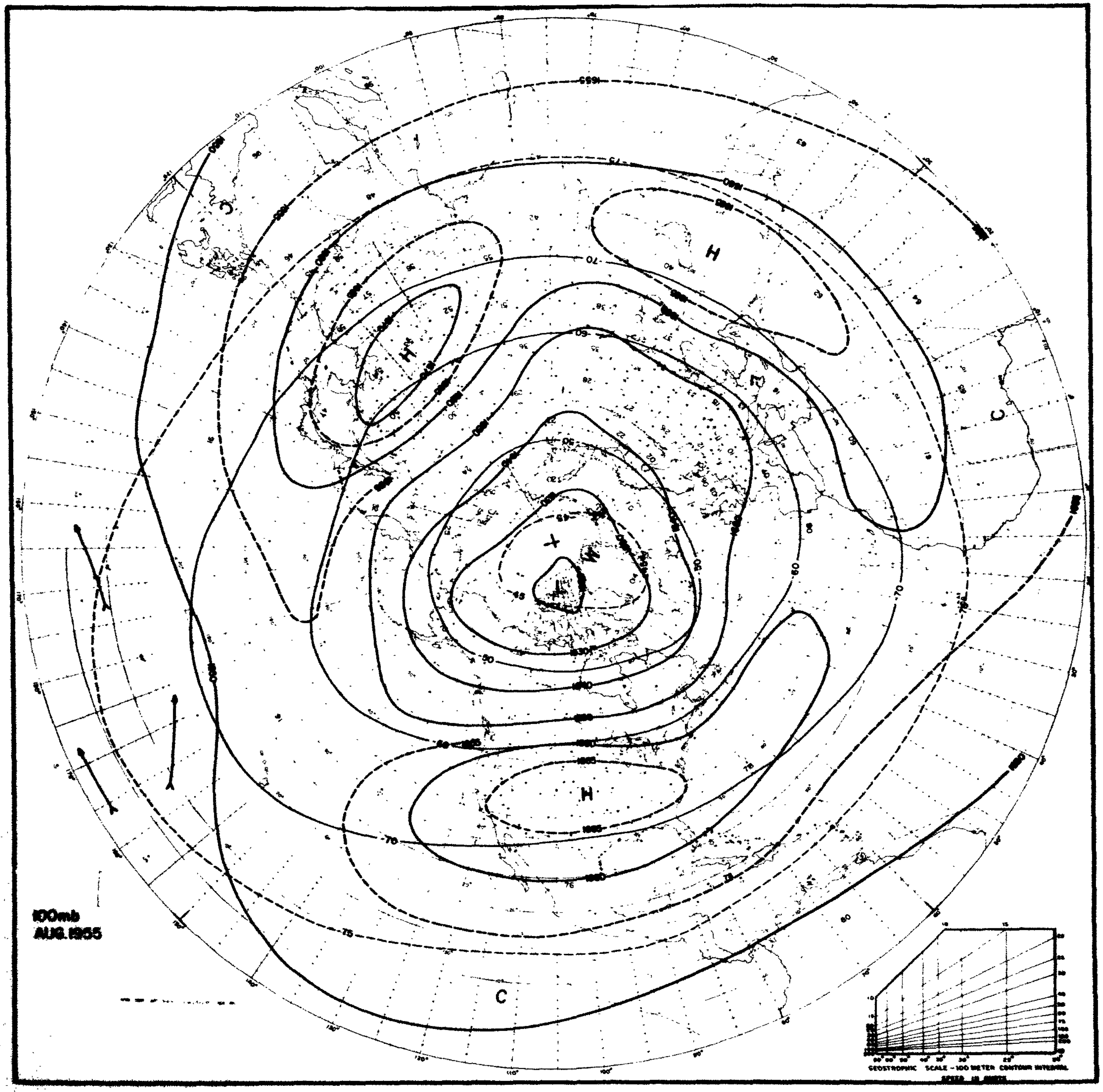
25 mb
JULY 1957
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
2510
2520
2530
2540
2550
2560
2570
2580
H
X
C
C
C

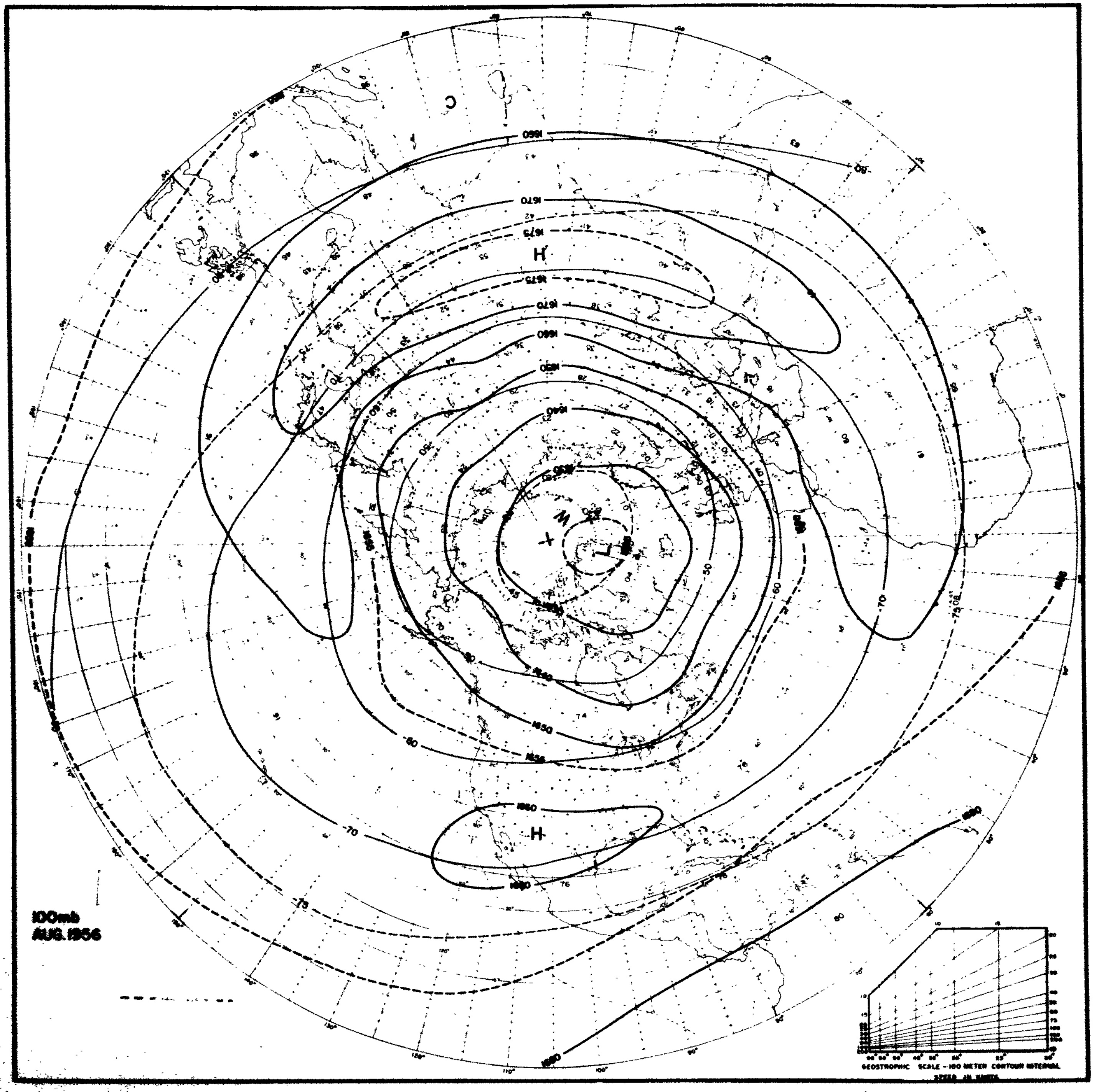


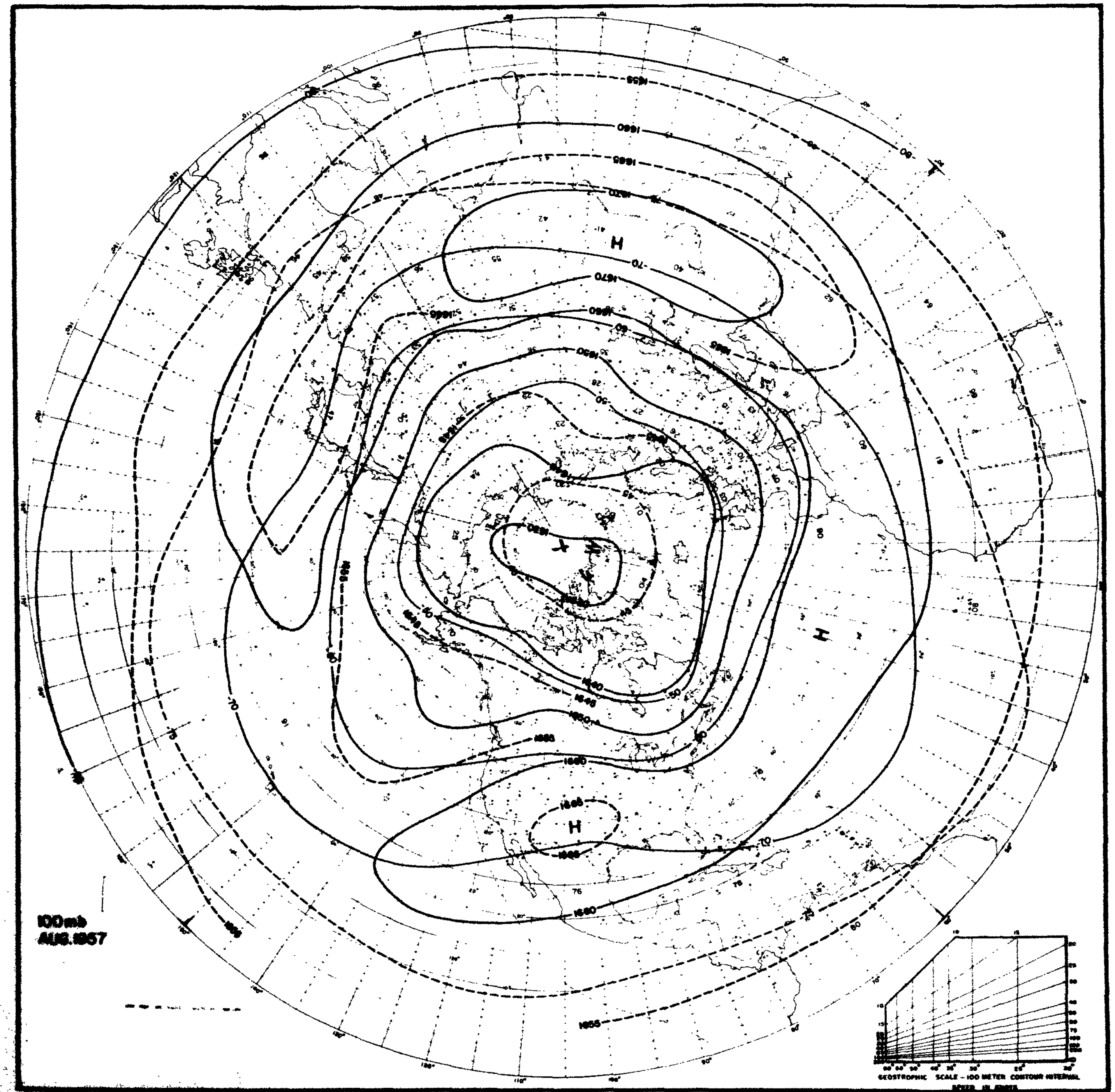
25mb
JULY 1958
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS


25 mb
JULY 1969
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
2515
2520
2530
2540
2550
2560
2570
2580
2590
C
H
W

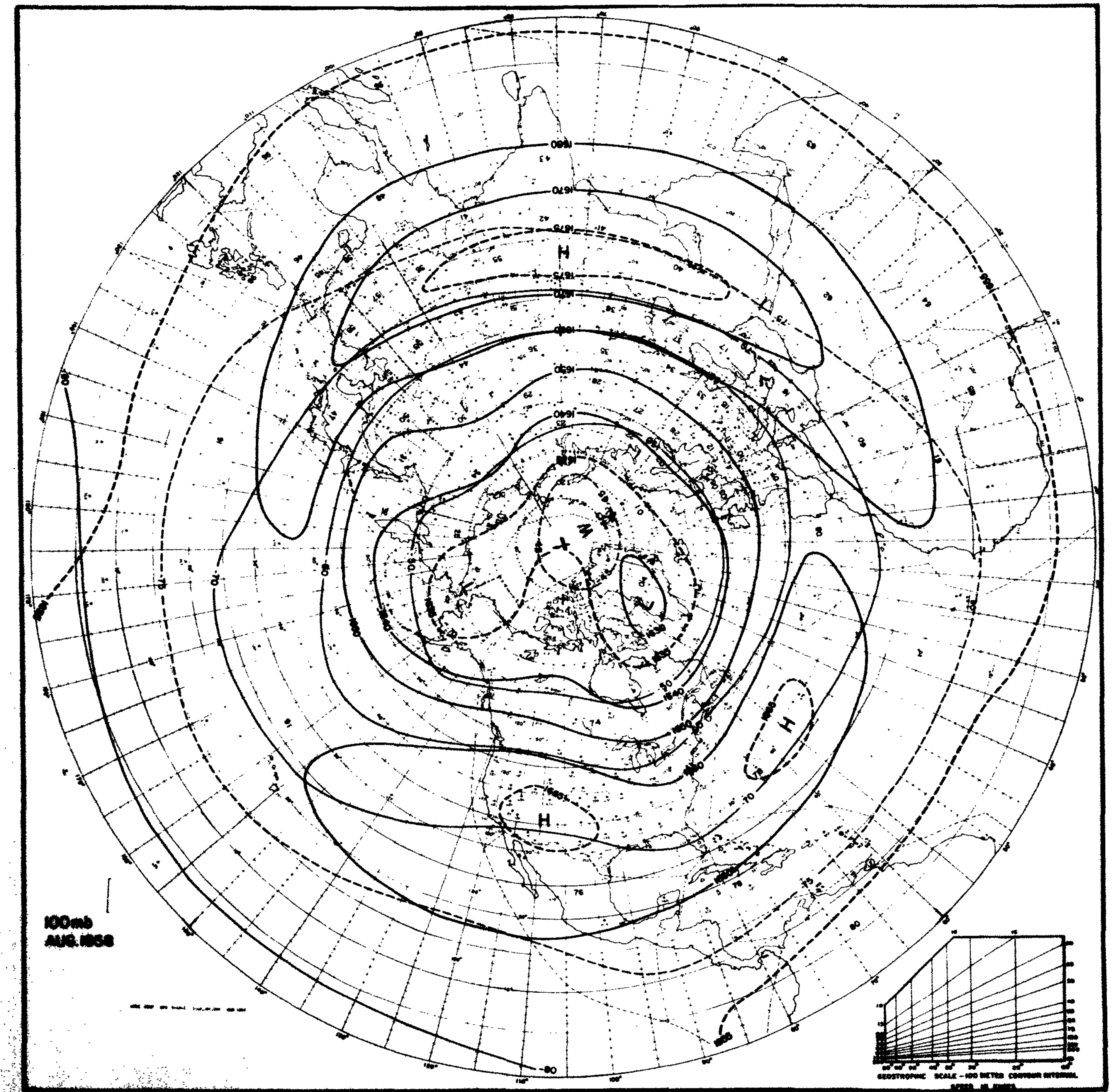

100mb AUGUST
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS
H
H
H
C
C
1640
1650
1655
1660

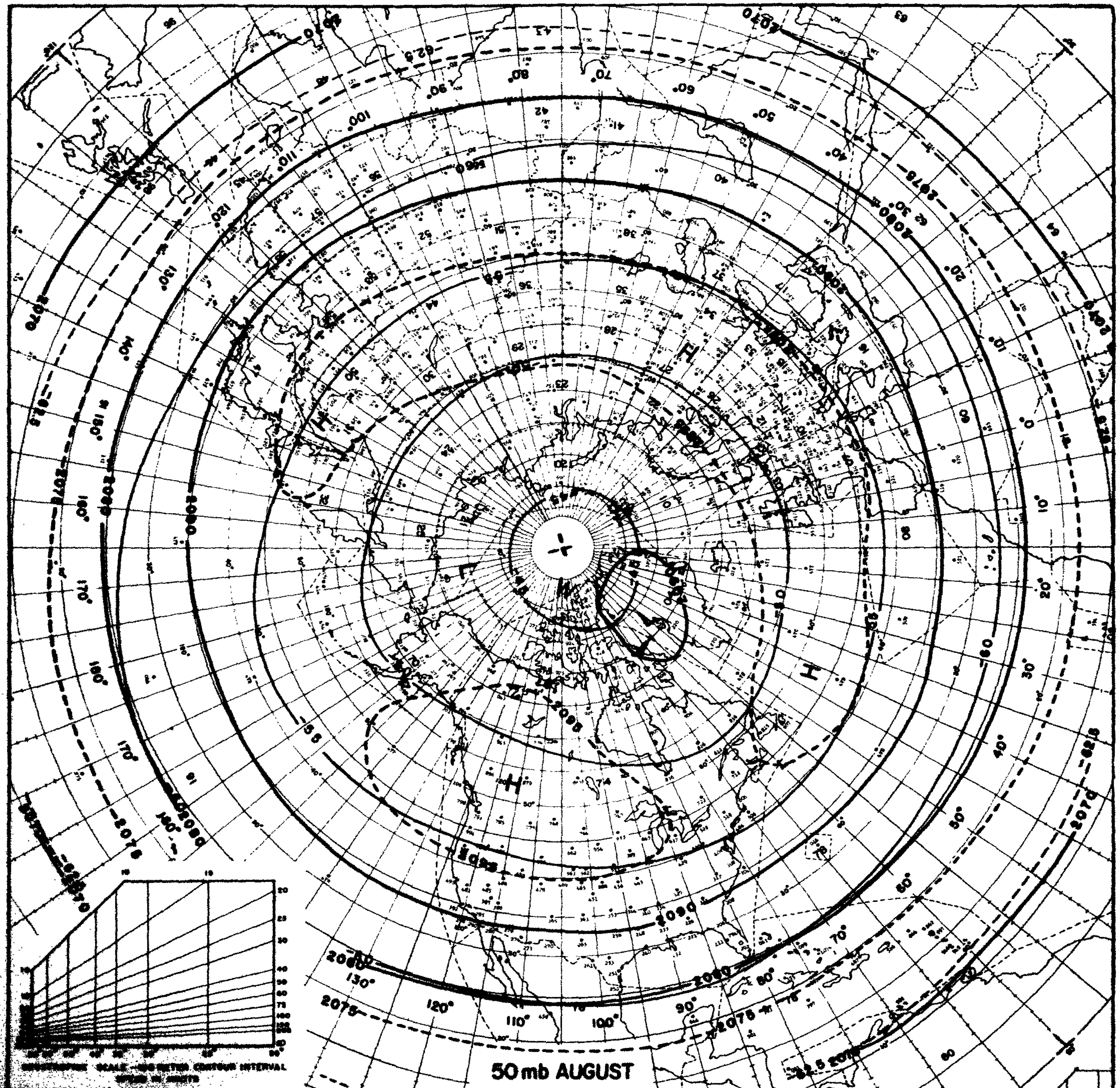

100mb
AUG. 1955
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

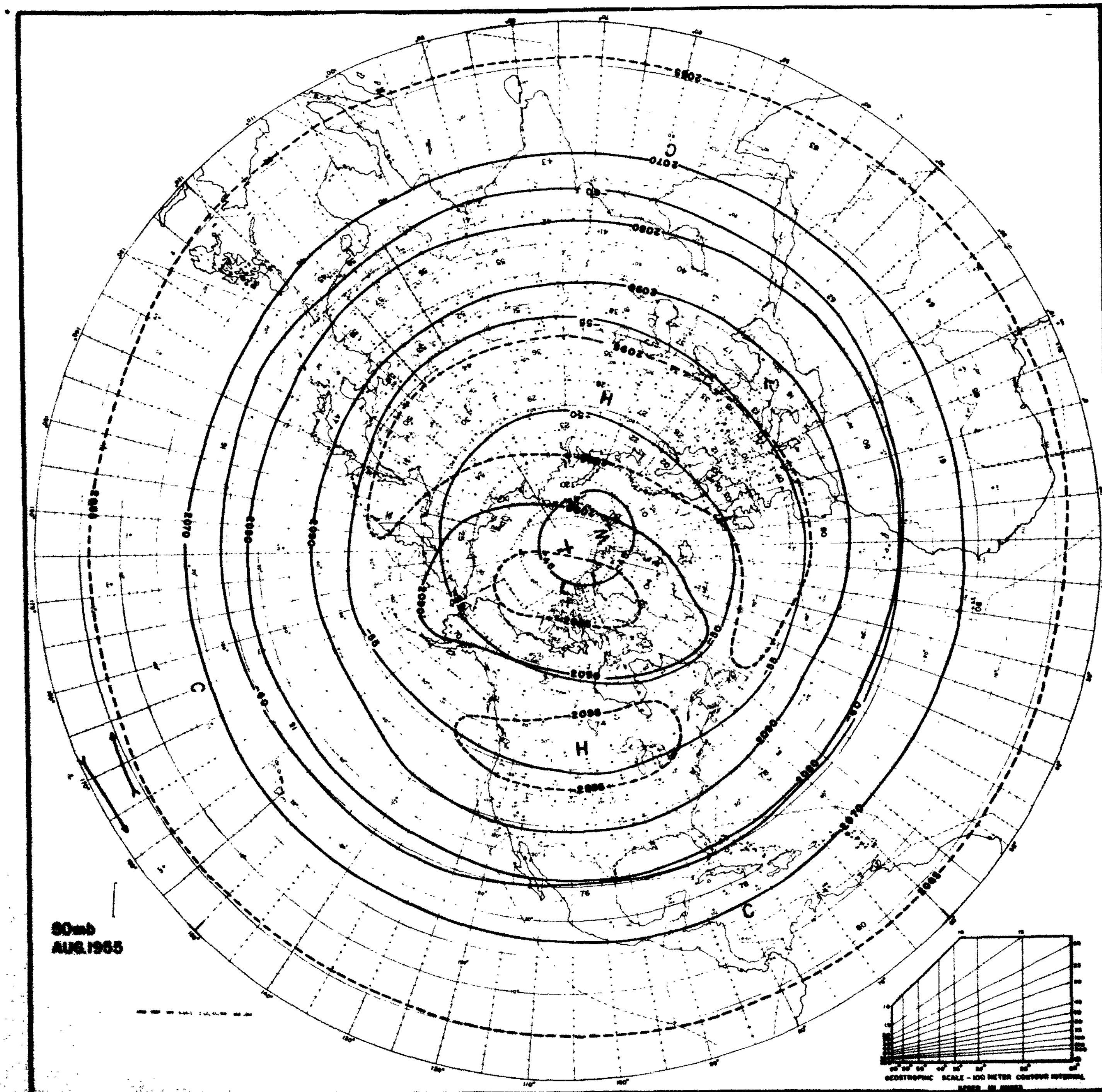

100mb
AUG. 1956
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS
H
H
L
W
C
1680
1670
1675
1660
1650
1640
-70
-75
-80
-60
-50



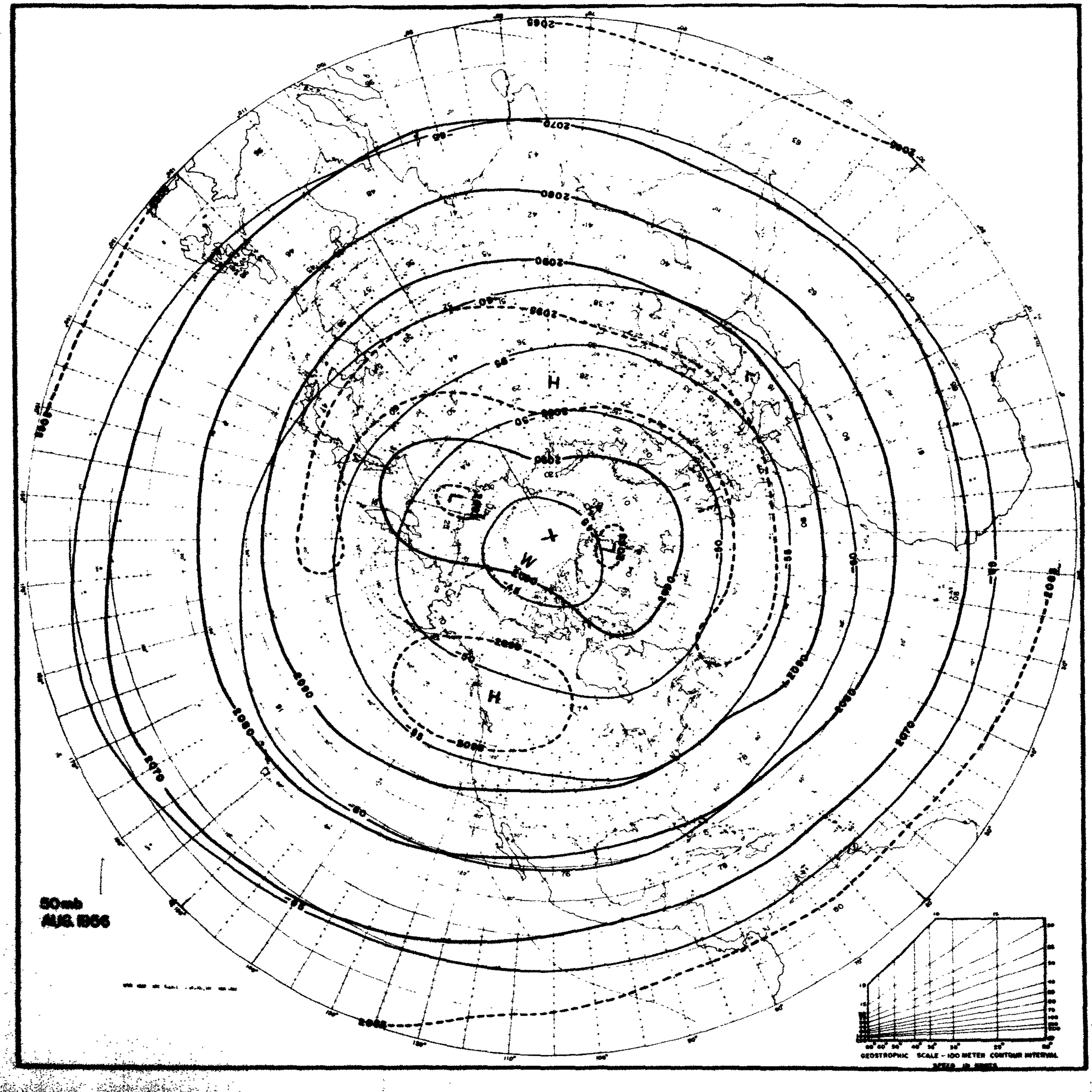
100mb
AUG.1957
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

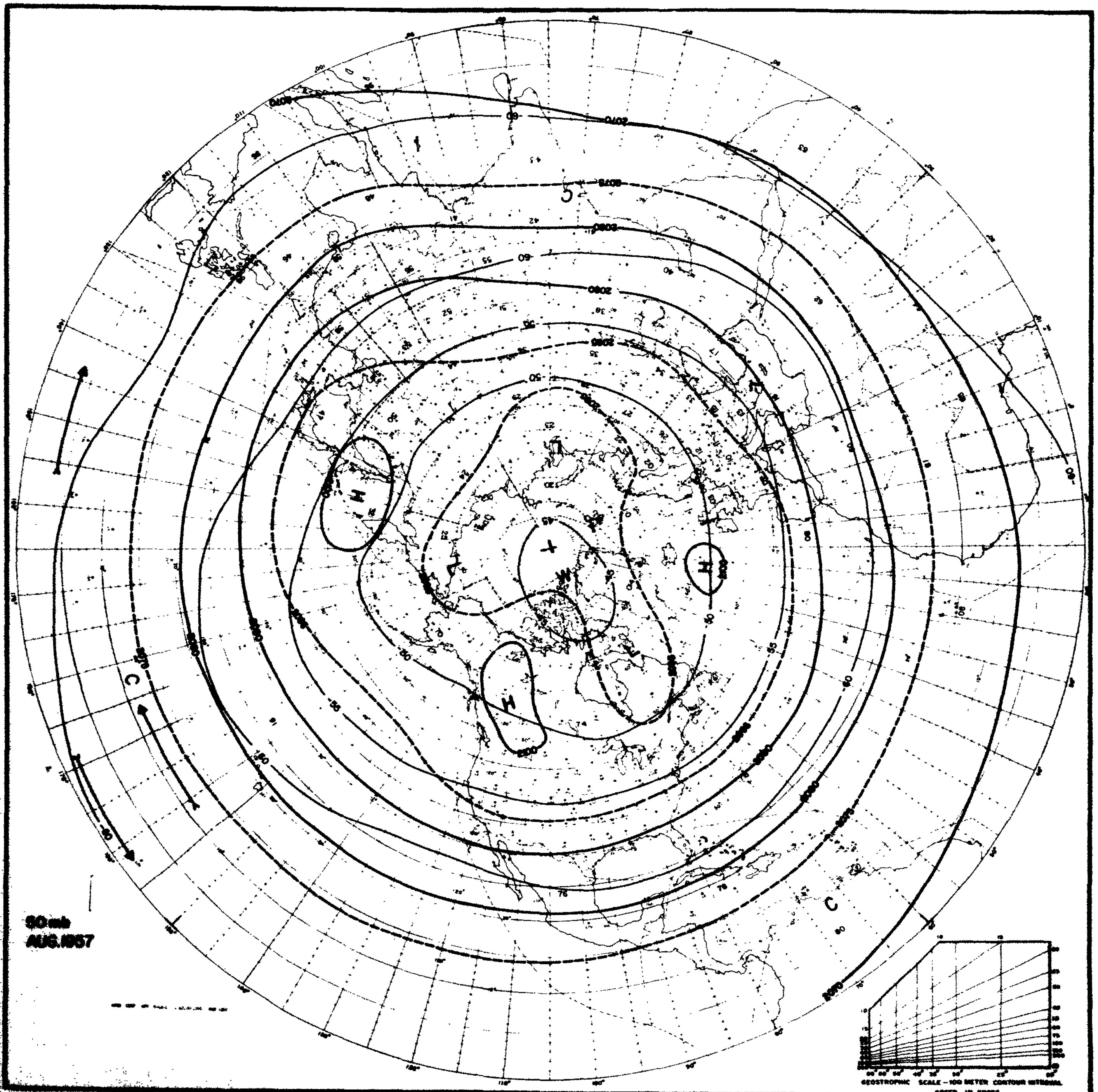

100mb
AUG. 1958
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

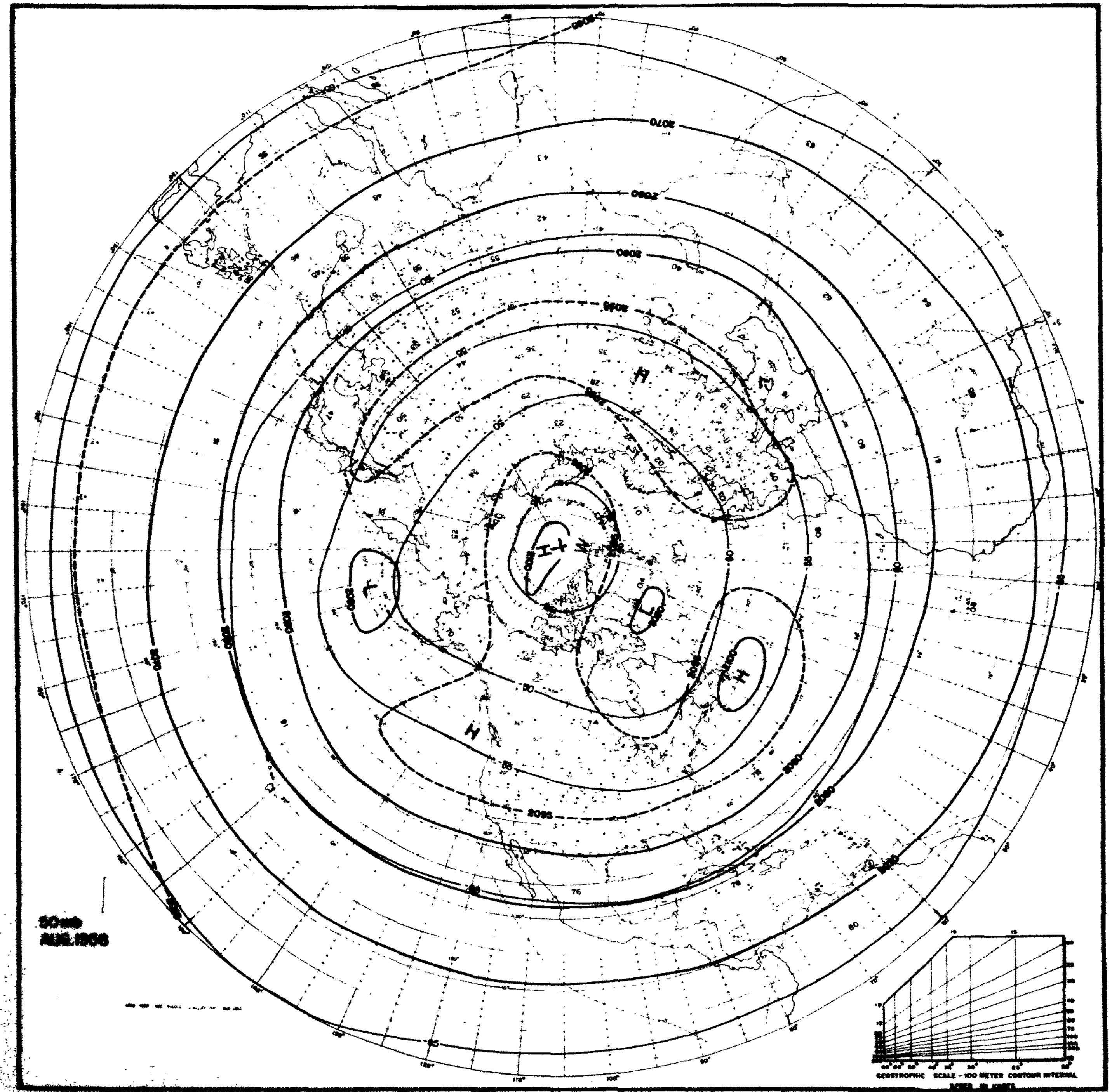

50 mb AUGUST



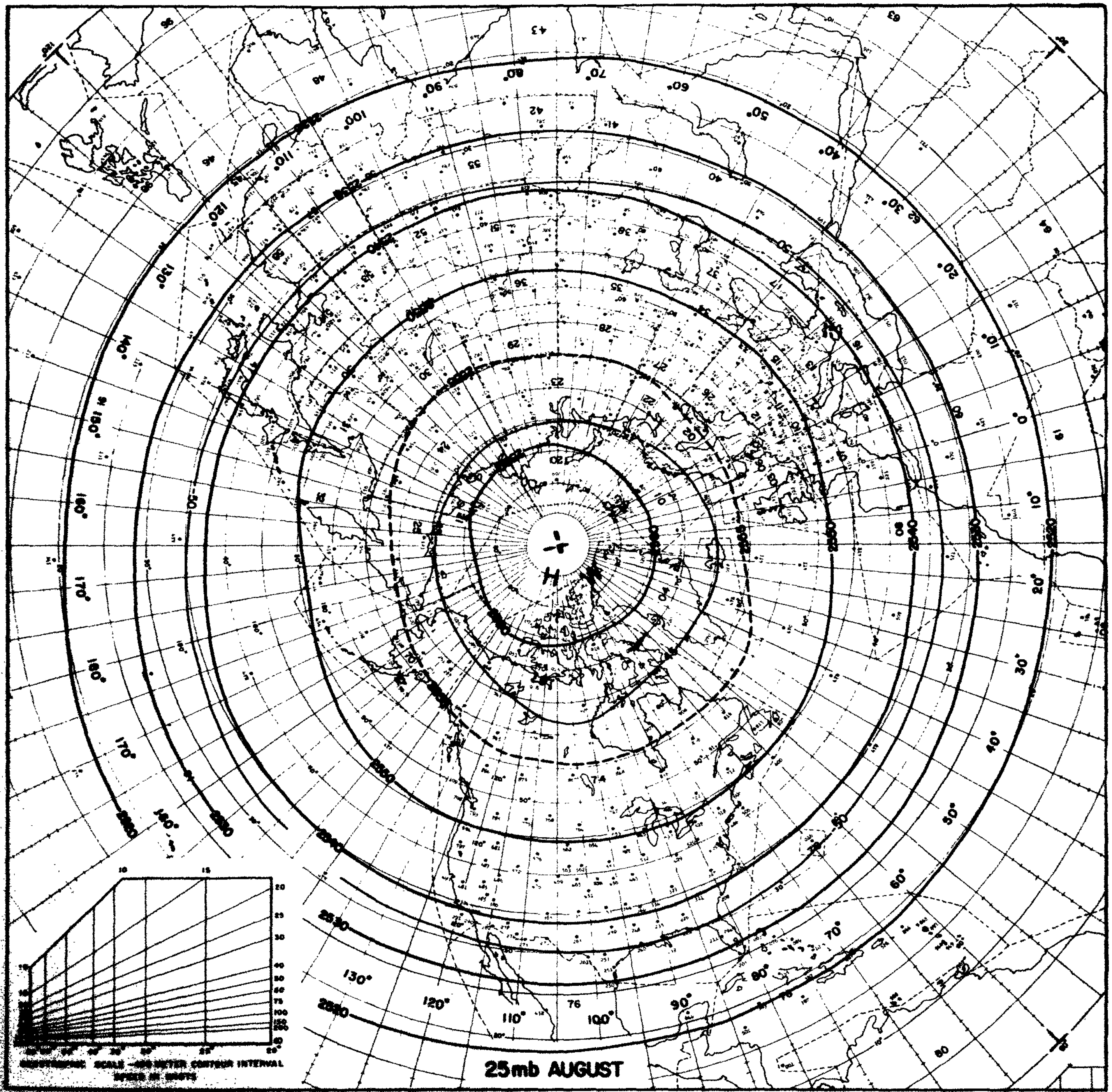
50mb
AUG.1965
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL


50 mb
AUG. 1966
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

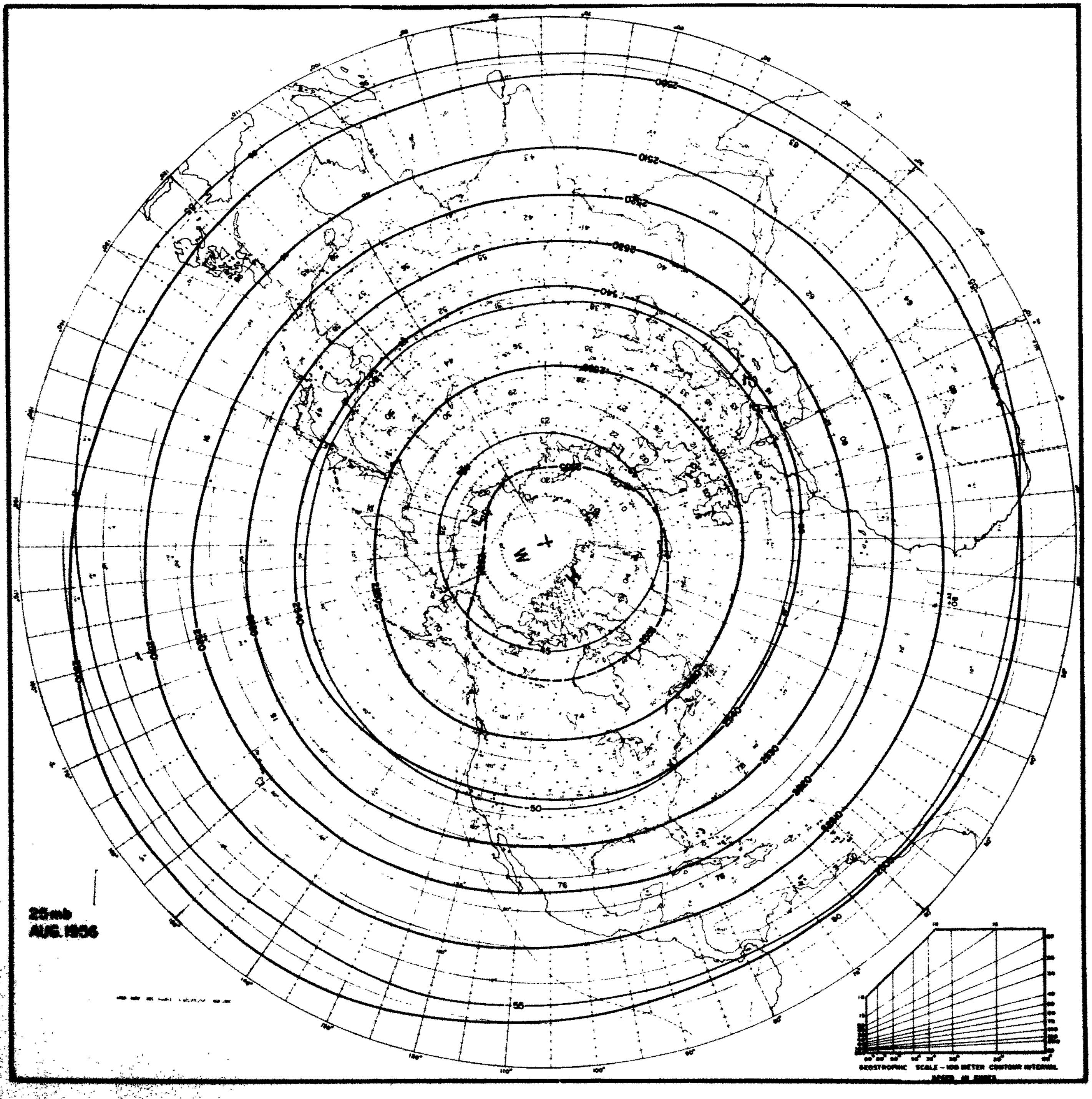

50 mb
AUG.1957
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS



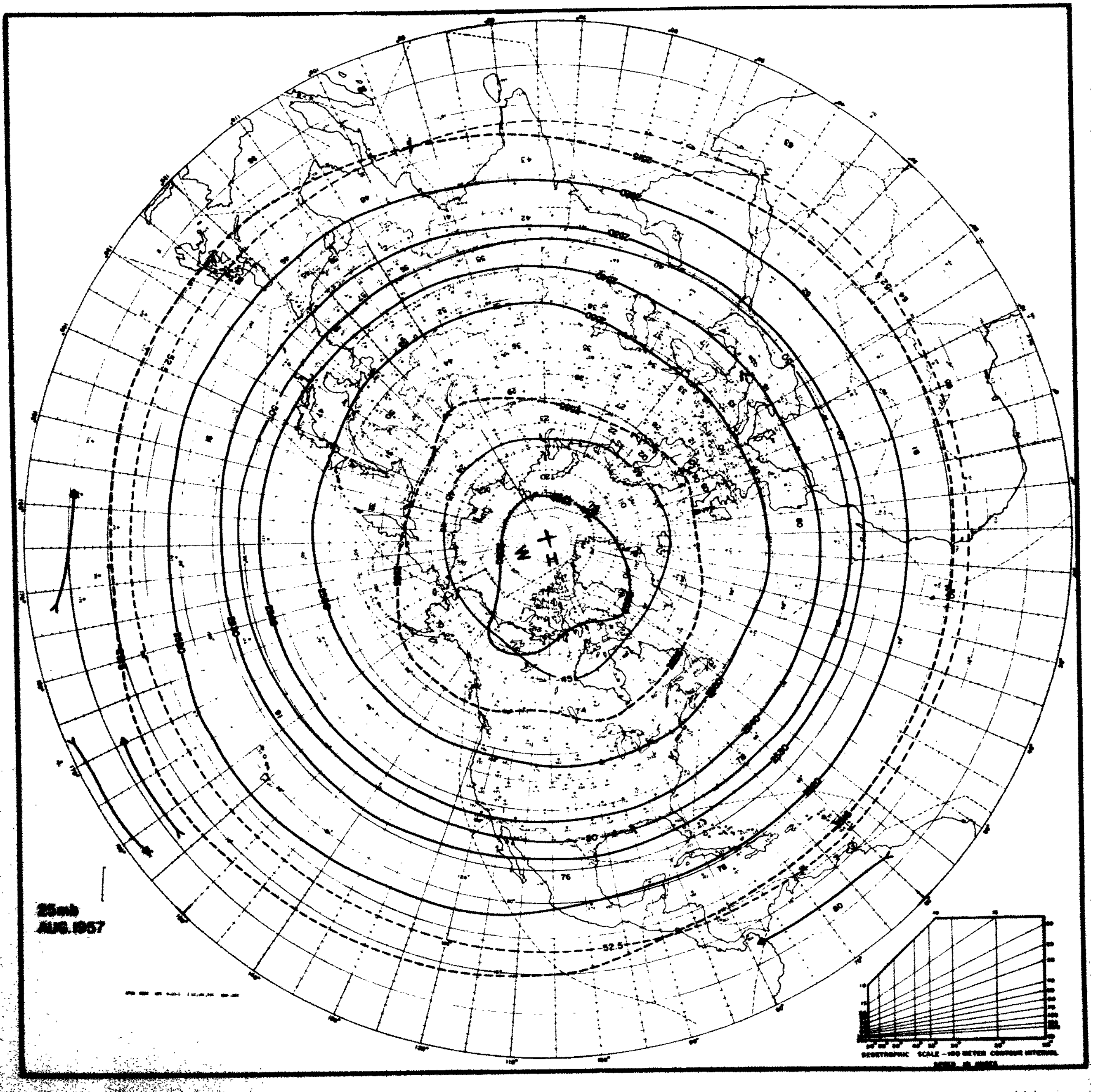
2070
2080
2090
2095
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS



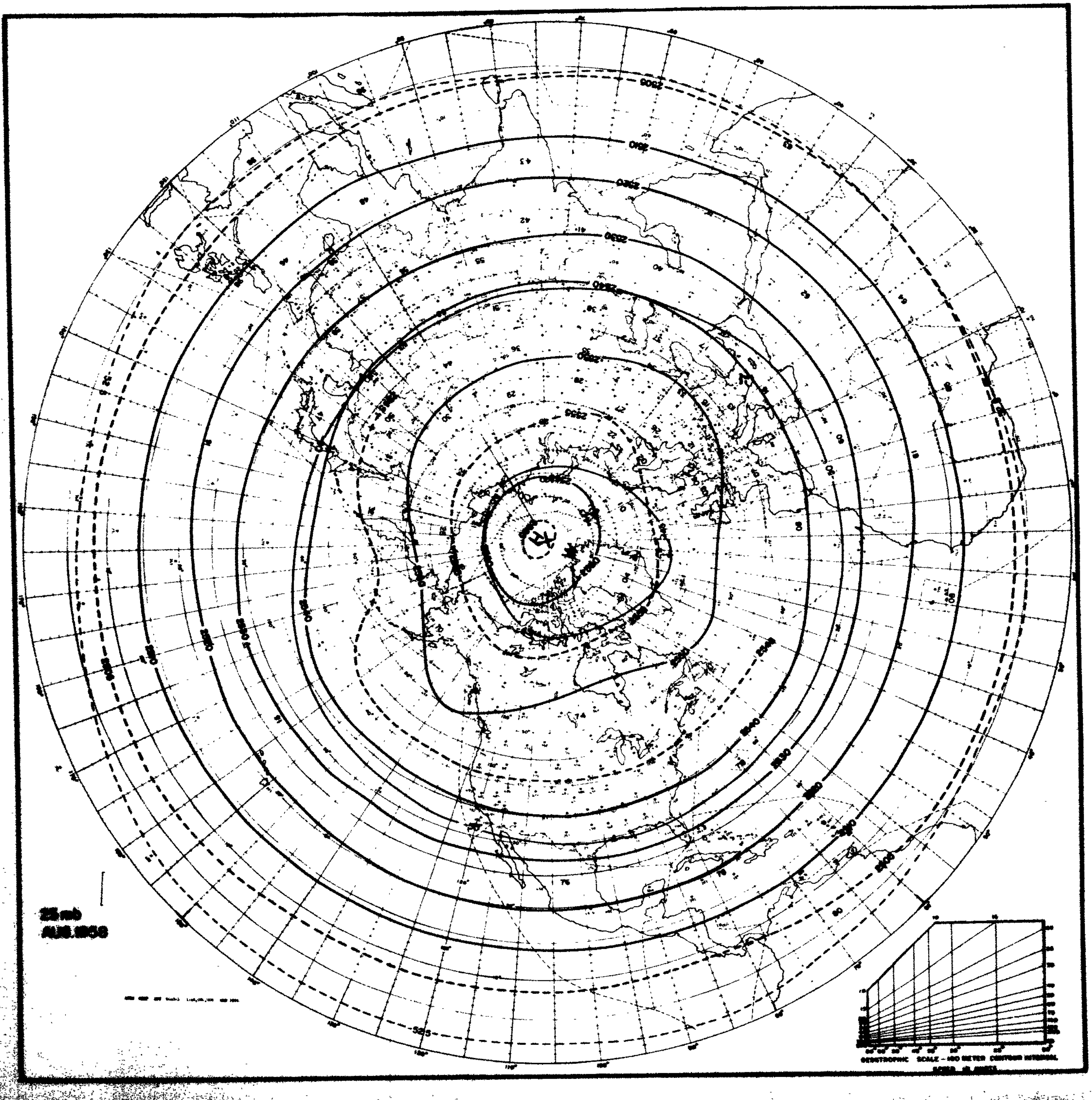
25mb AUGUST



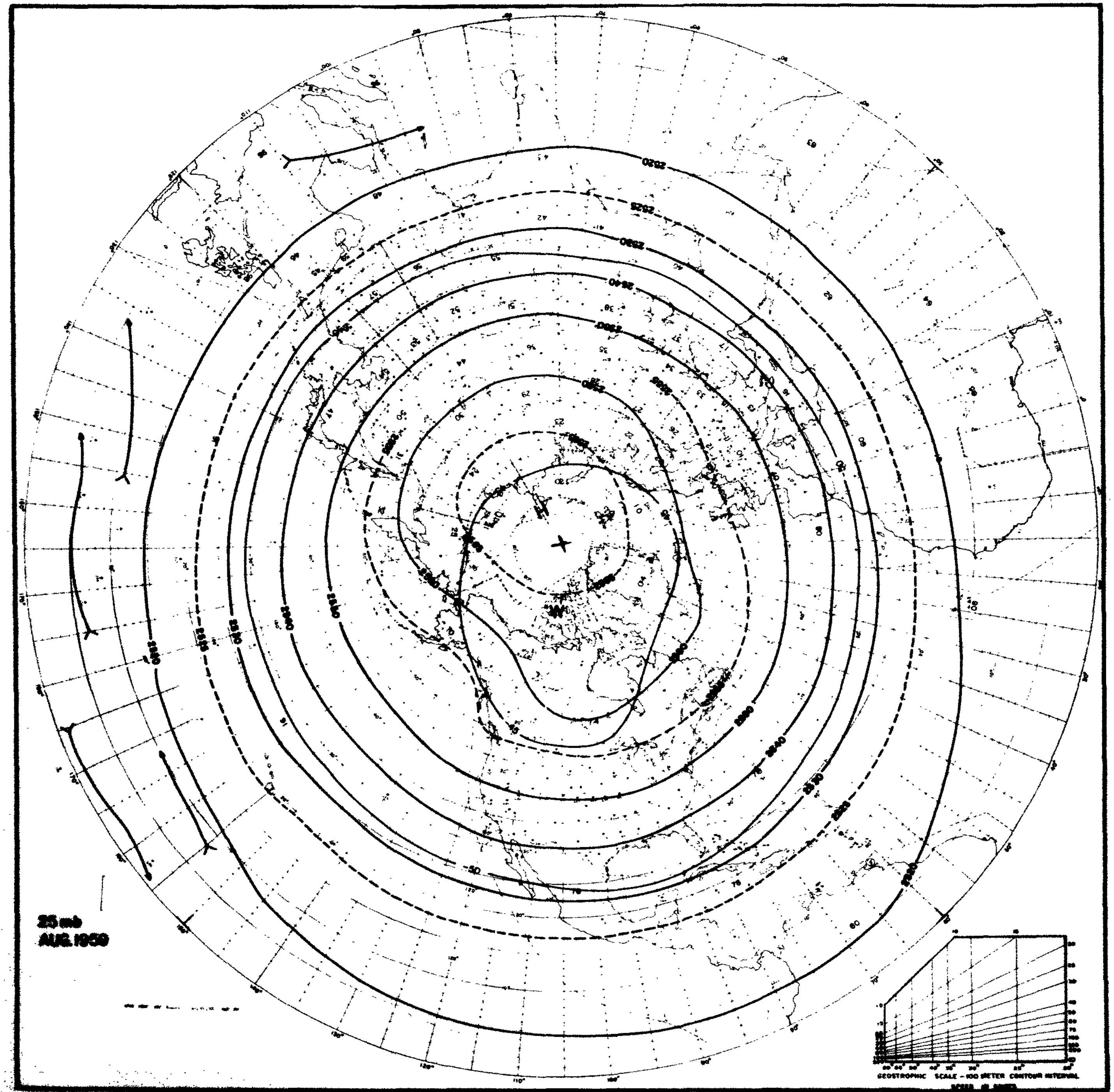
25mb
AUG. 1956
GEOSTROPHIC SCALE — 100 METER CONTOUR INTERVAL



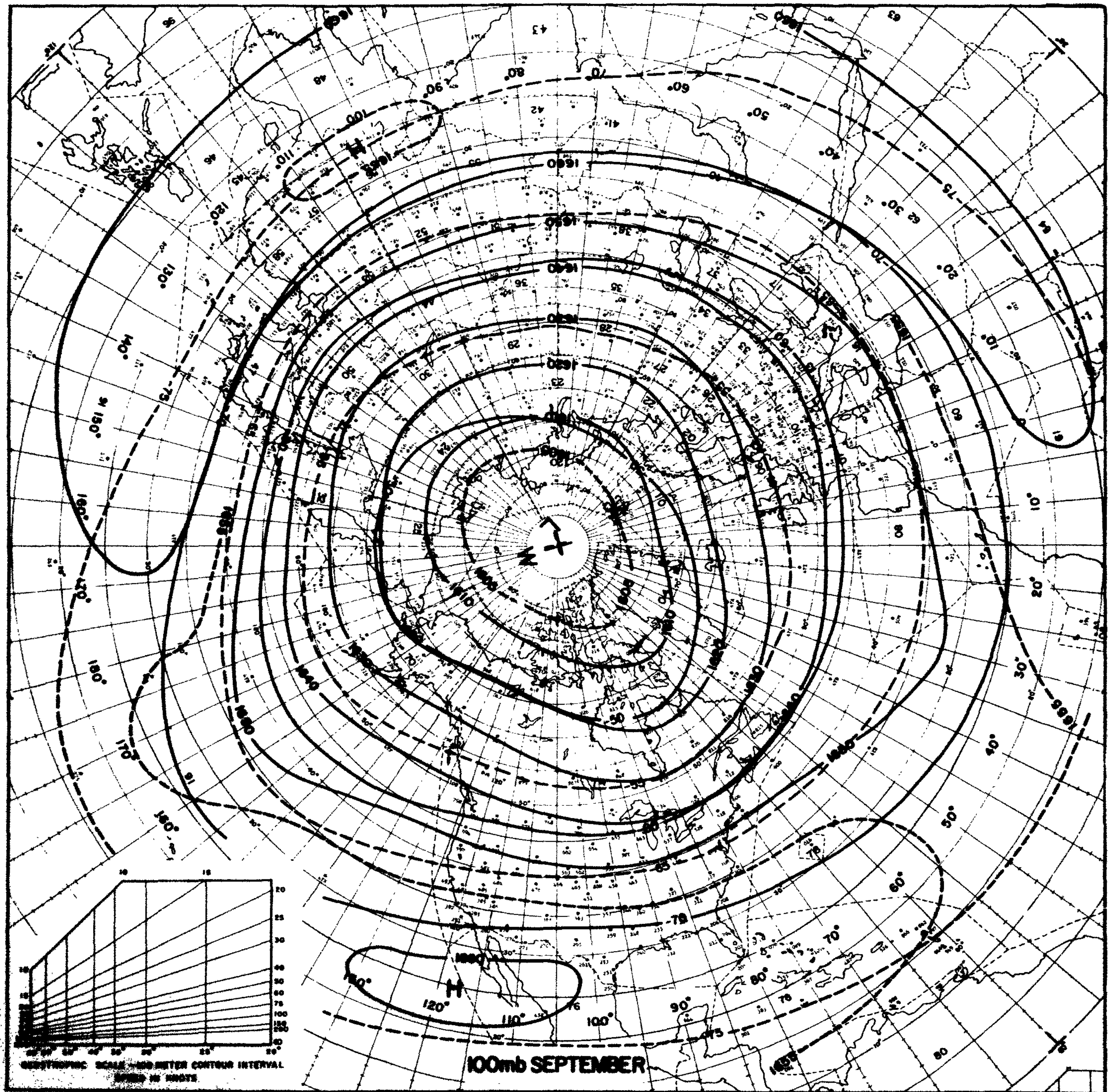
25mb
AUG. 1957



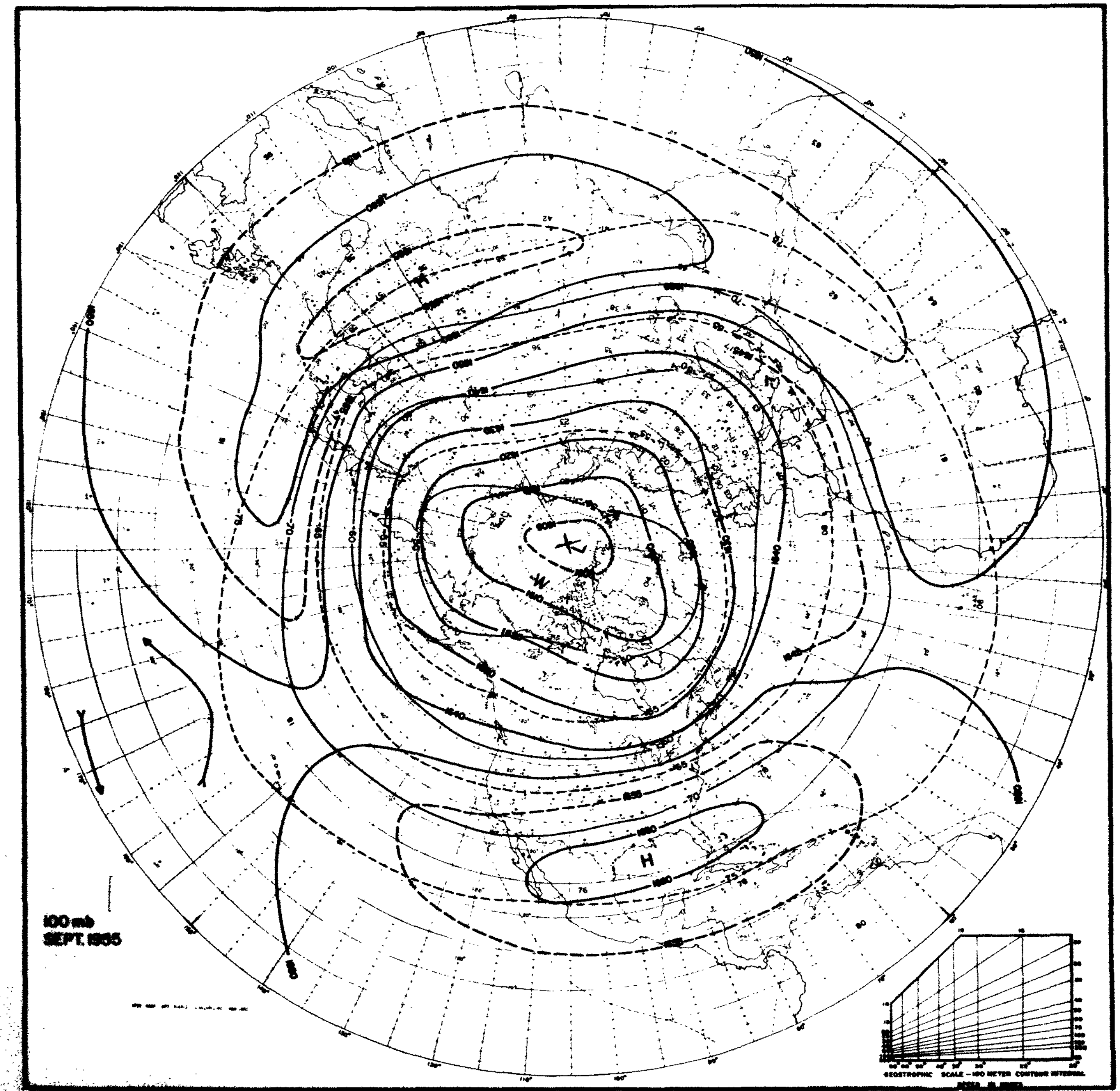
25 mb
AUG.1958
GEOSTROPHIC SCALE

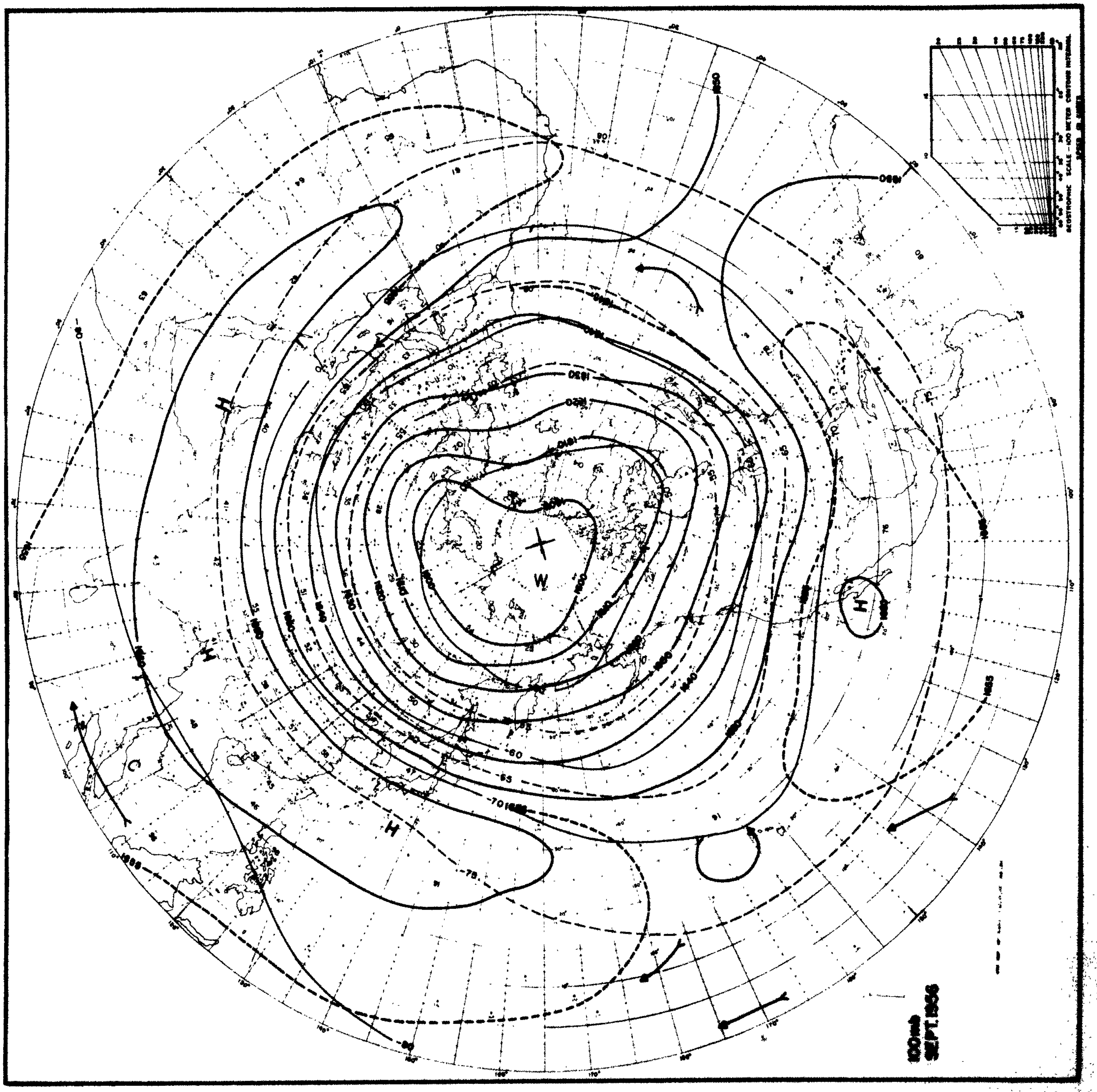


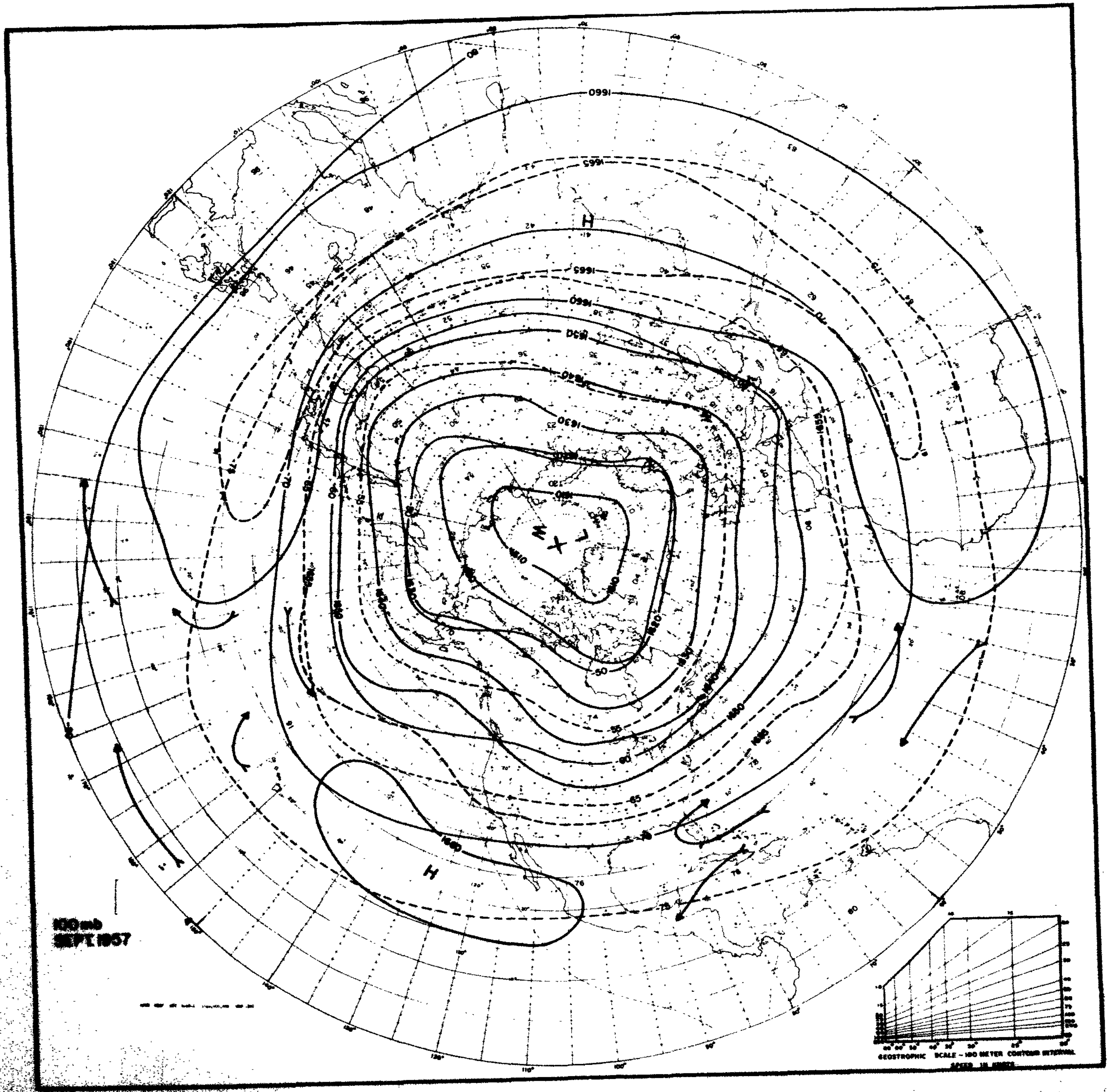
25 mb
AUG. 1959
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

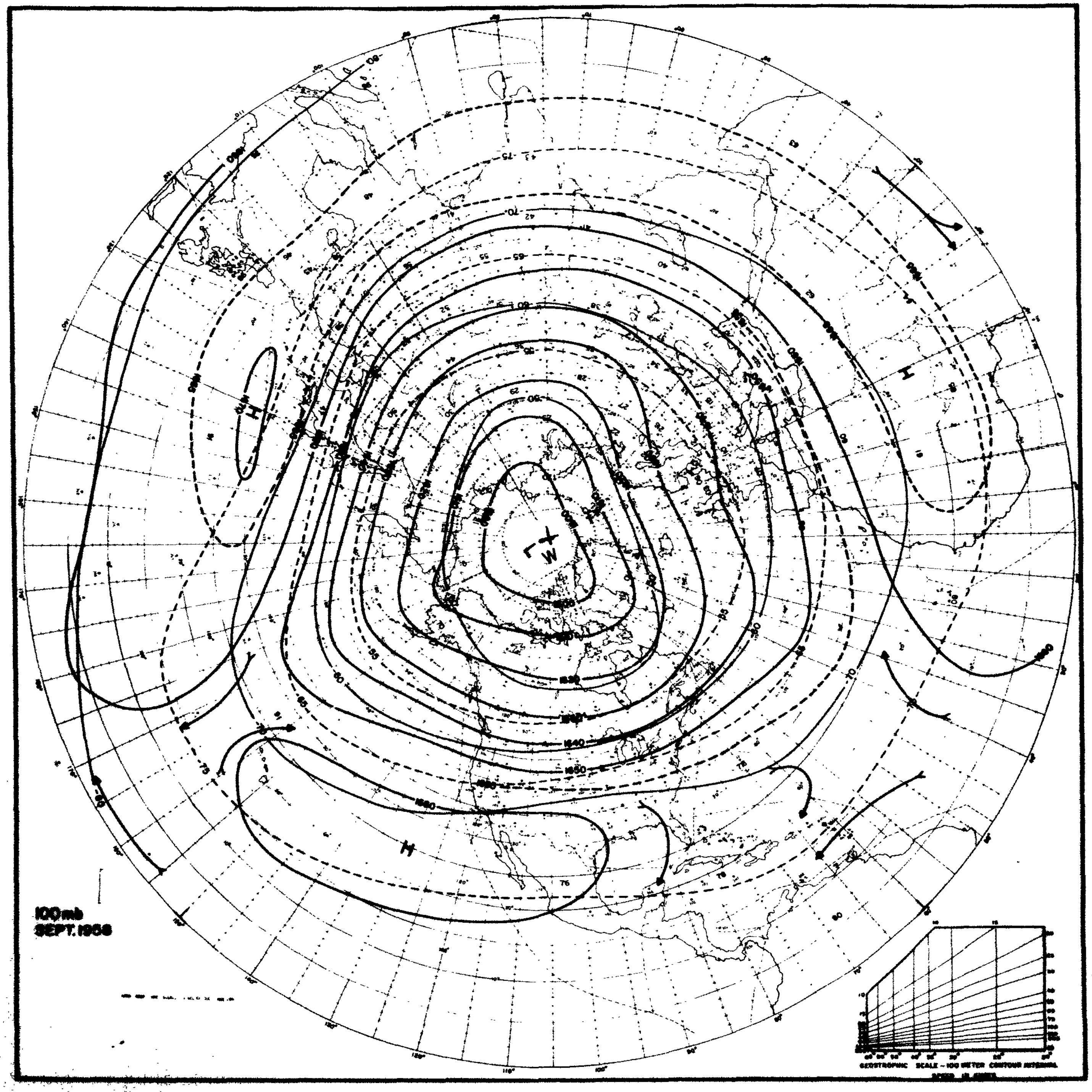


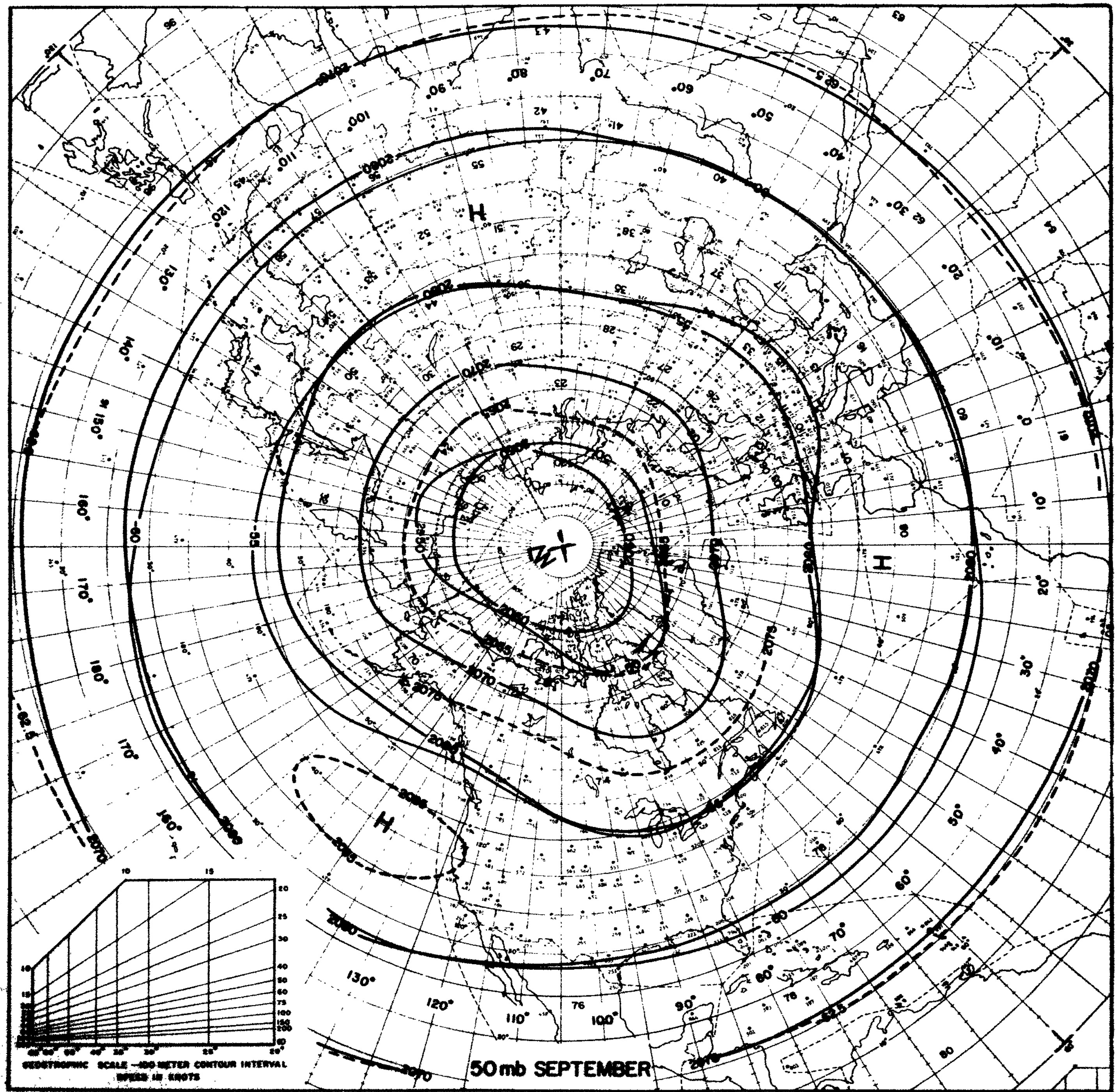
100mb SEPTEMBER
GEOSTROPHIC SCALE - 100-METER CONTOUR INTERVAL
SPEED IN KNOTS

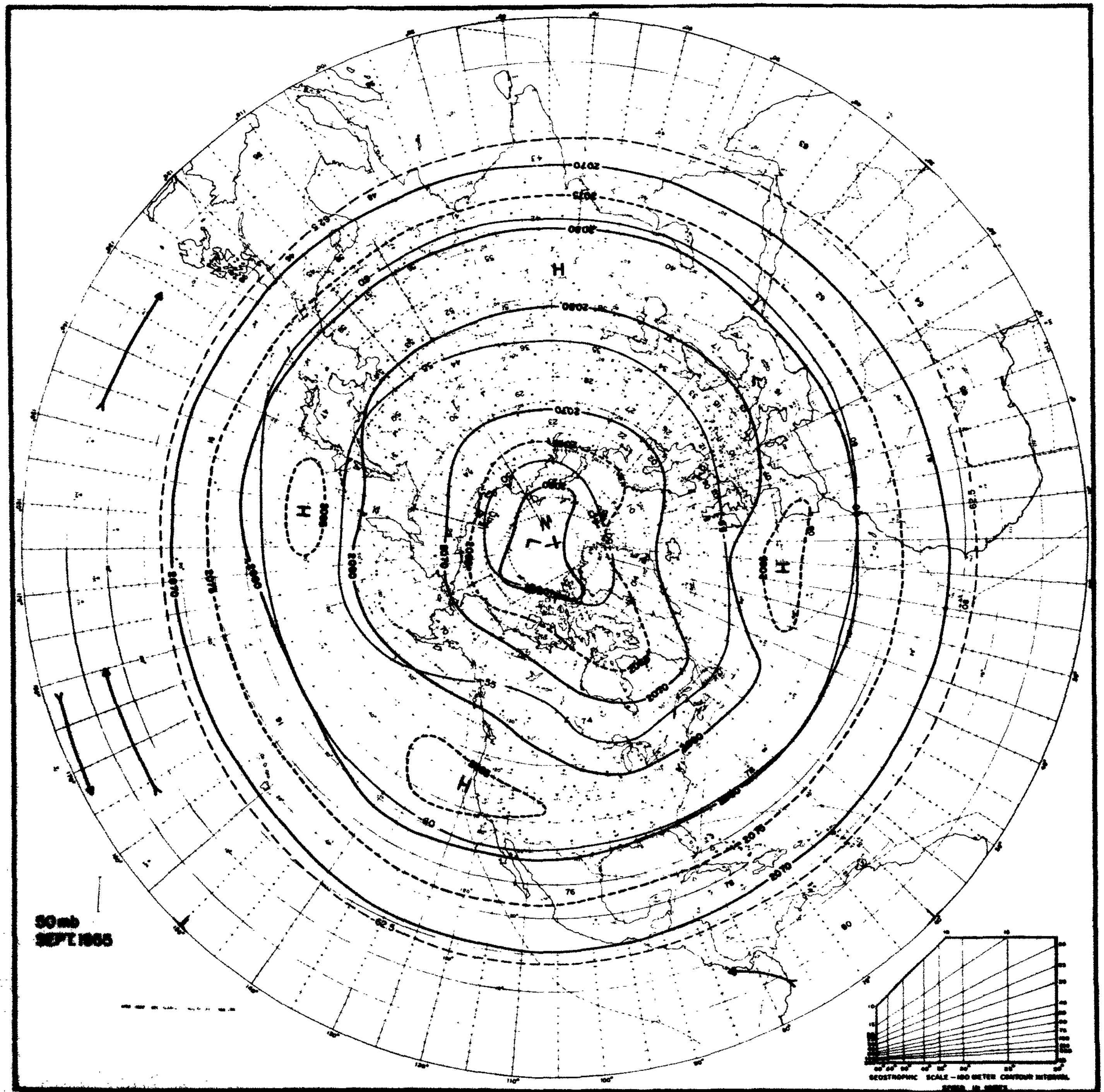

100 mb
SEPT. 1965
H
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS


100mb
SEPT. 1956

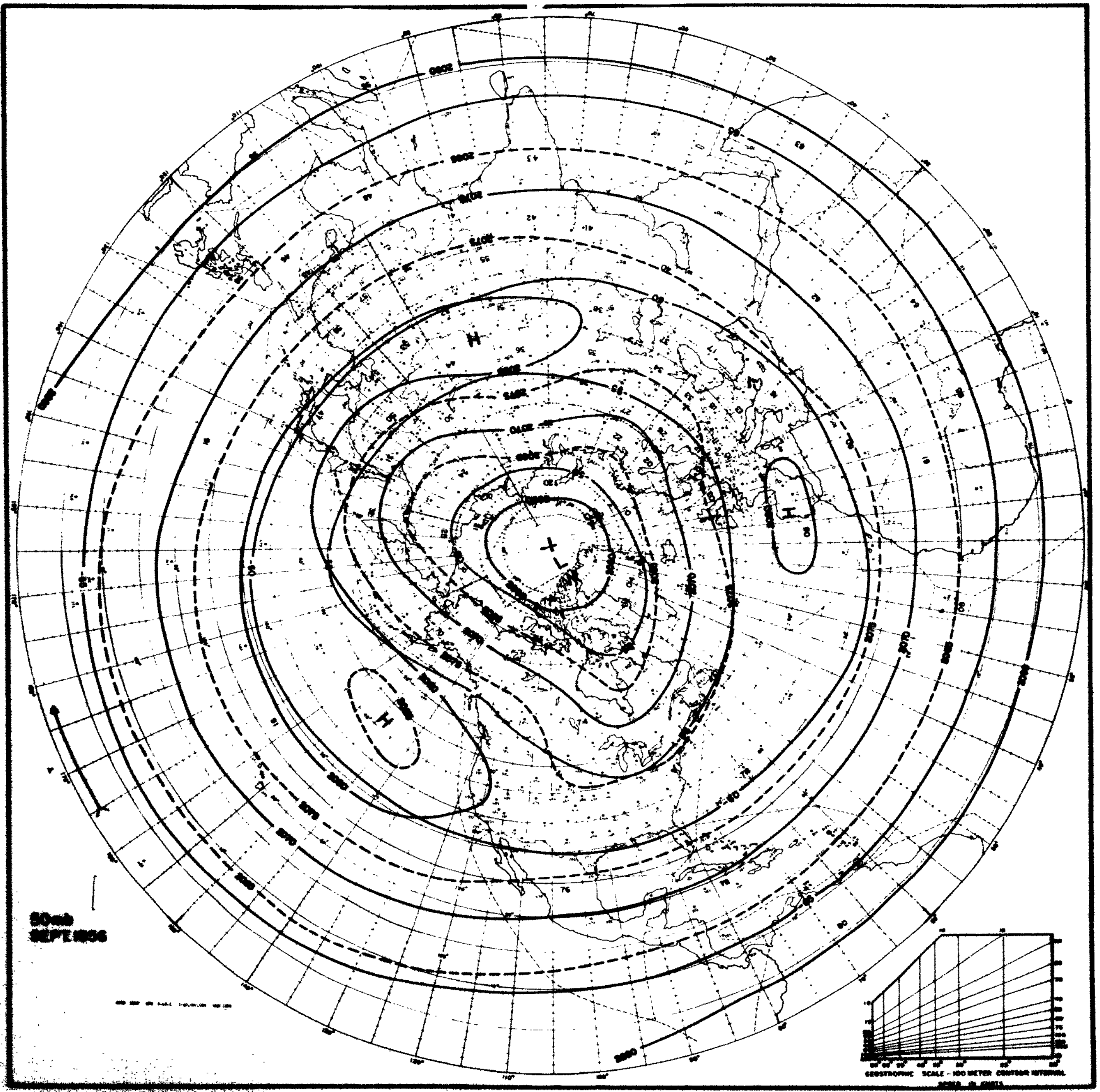

100 mb
SEPT. 1957
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS


100mb
SEPT. 1958
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

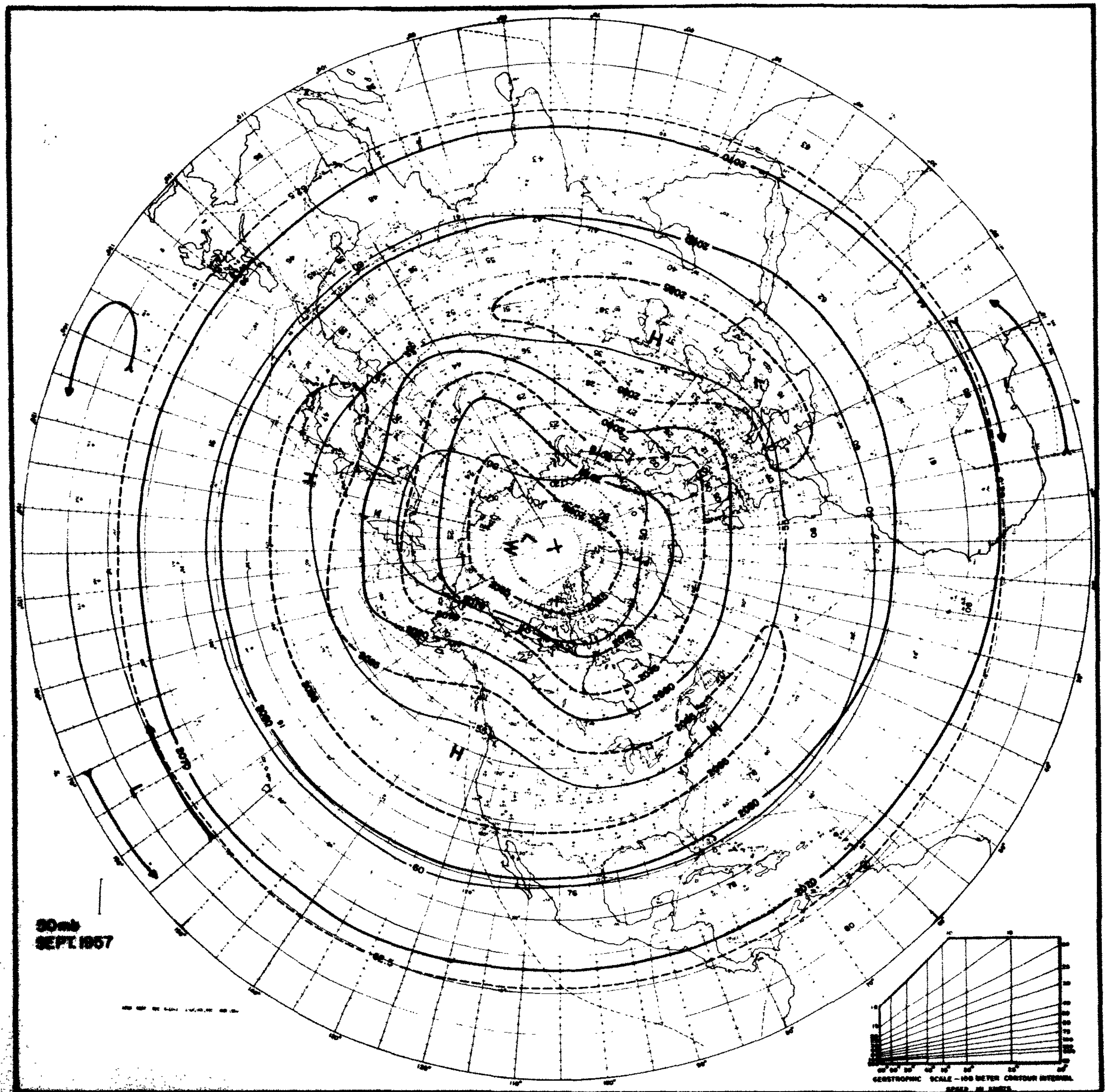

GEOSTROPHIC SCALE —100-METER CONTOUR INTERVAL
SPEED IN KNOTS
50 mb SEPTEMBER

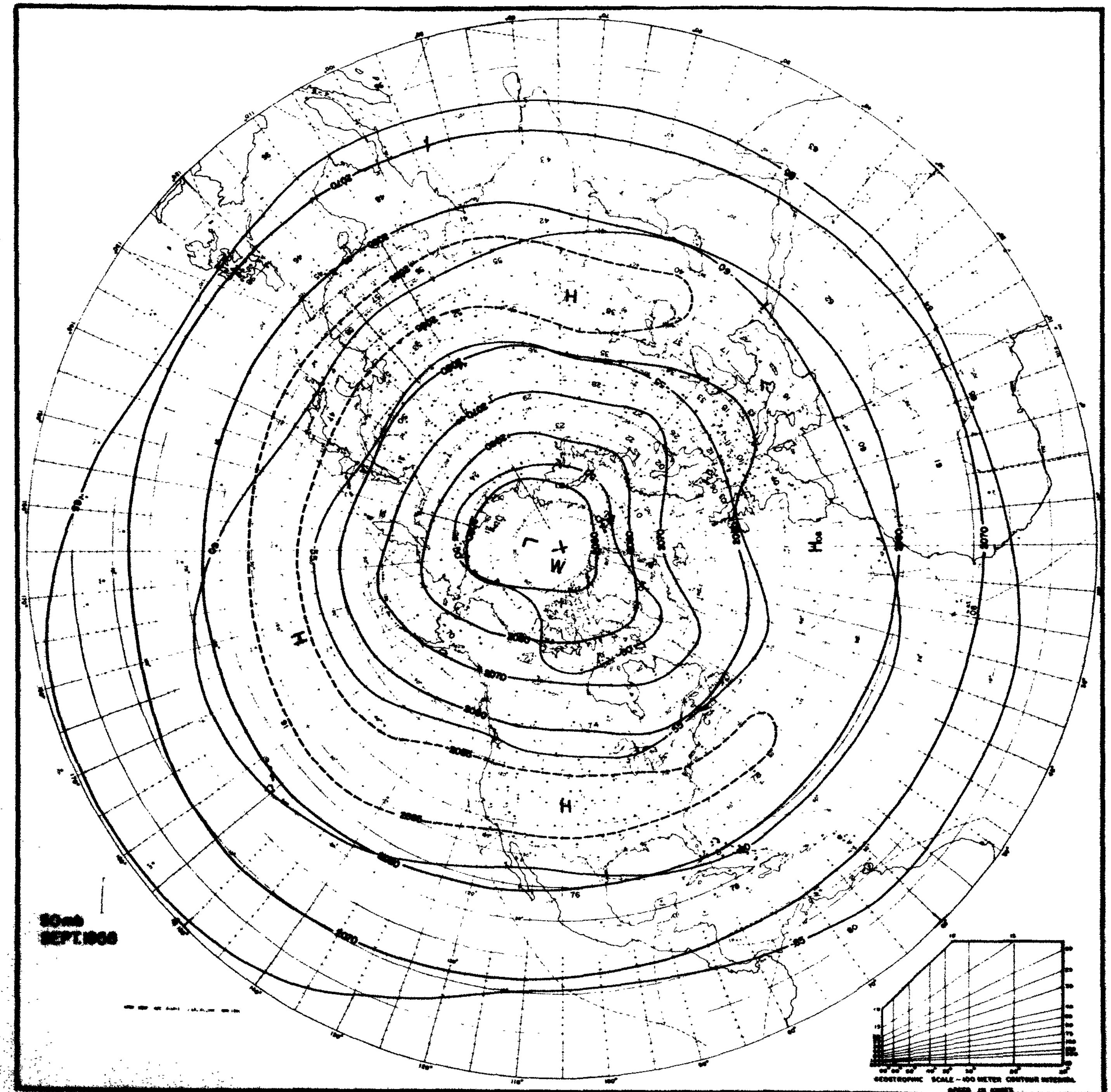


50 mb
SEPT. 1965
GEOSTROPHIC SCALE — 100 METER CONTOUR INTERVAL

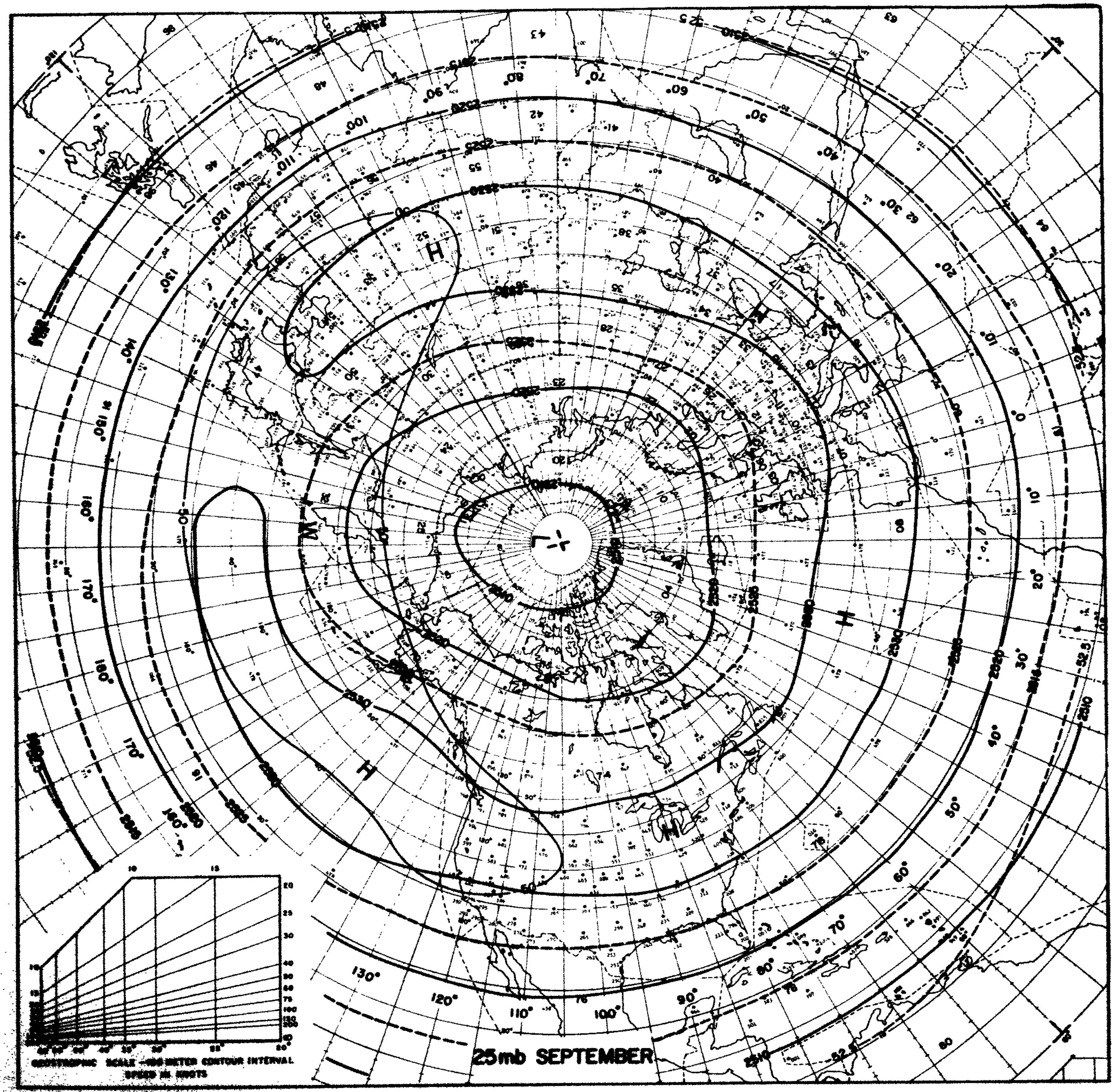


50mb
SEPT 1966
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

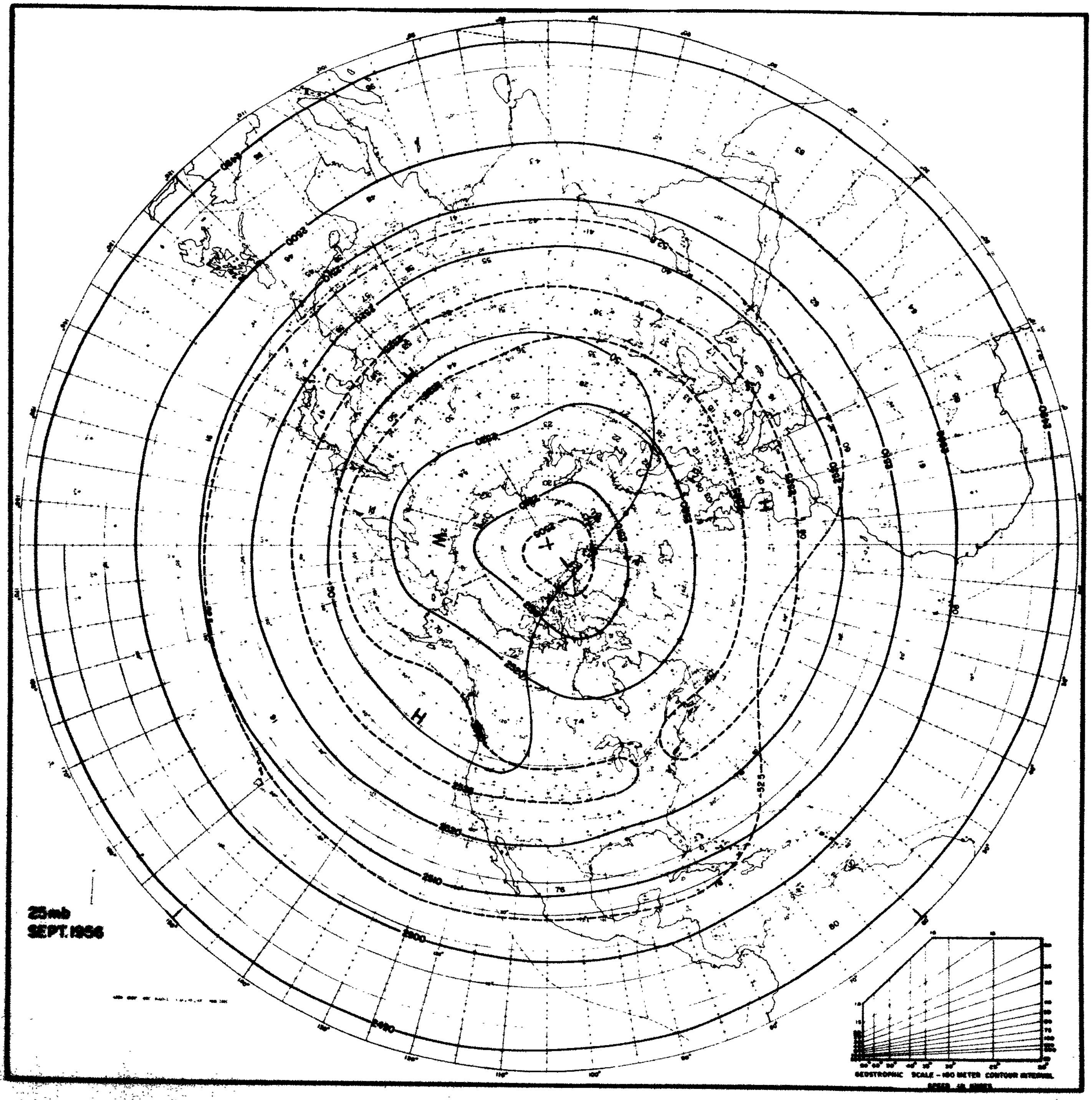

30mb
SEPT. 1957
GEOSTROPHIC SCALE — 100 METER CONTOUR INTERVAL

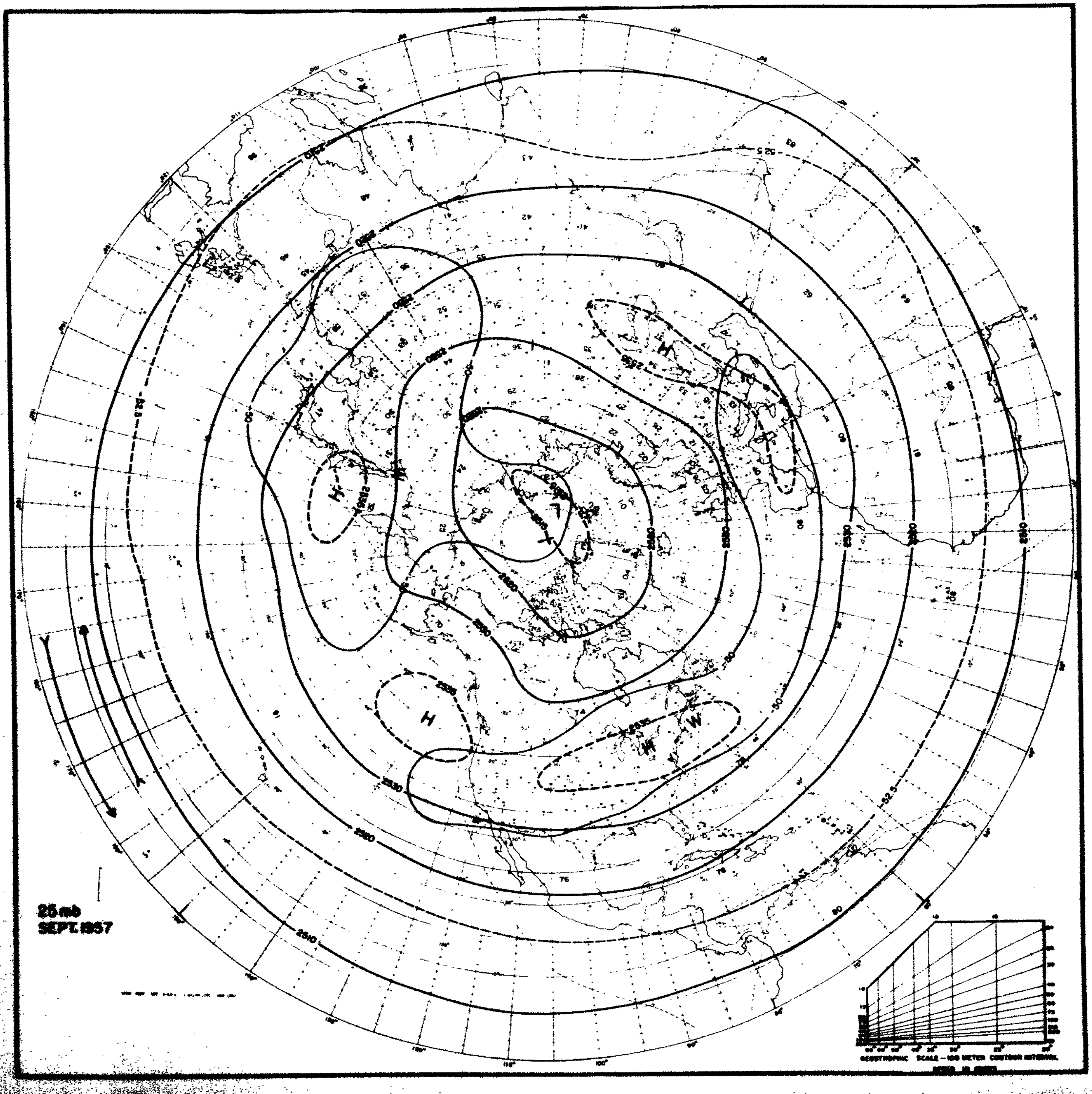


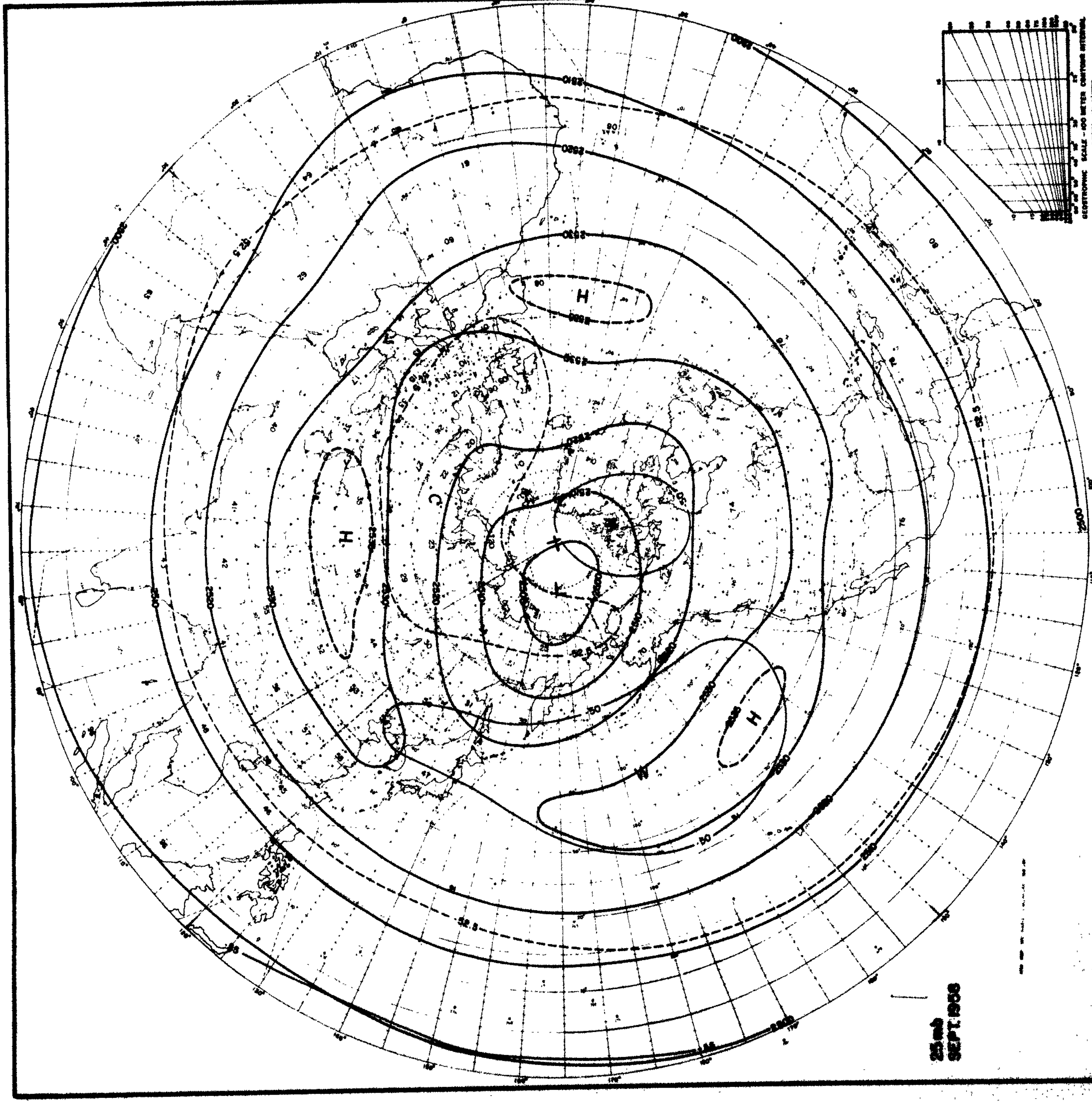
50mb
SEPT.1958
GEOSTROPHIC SCALE — 400 METER CONTOUR INTERVAL

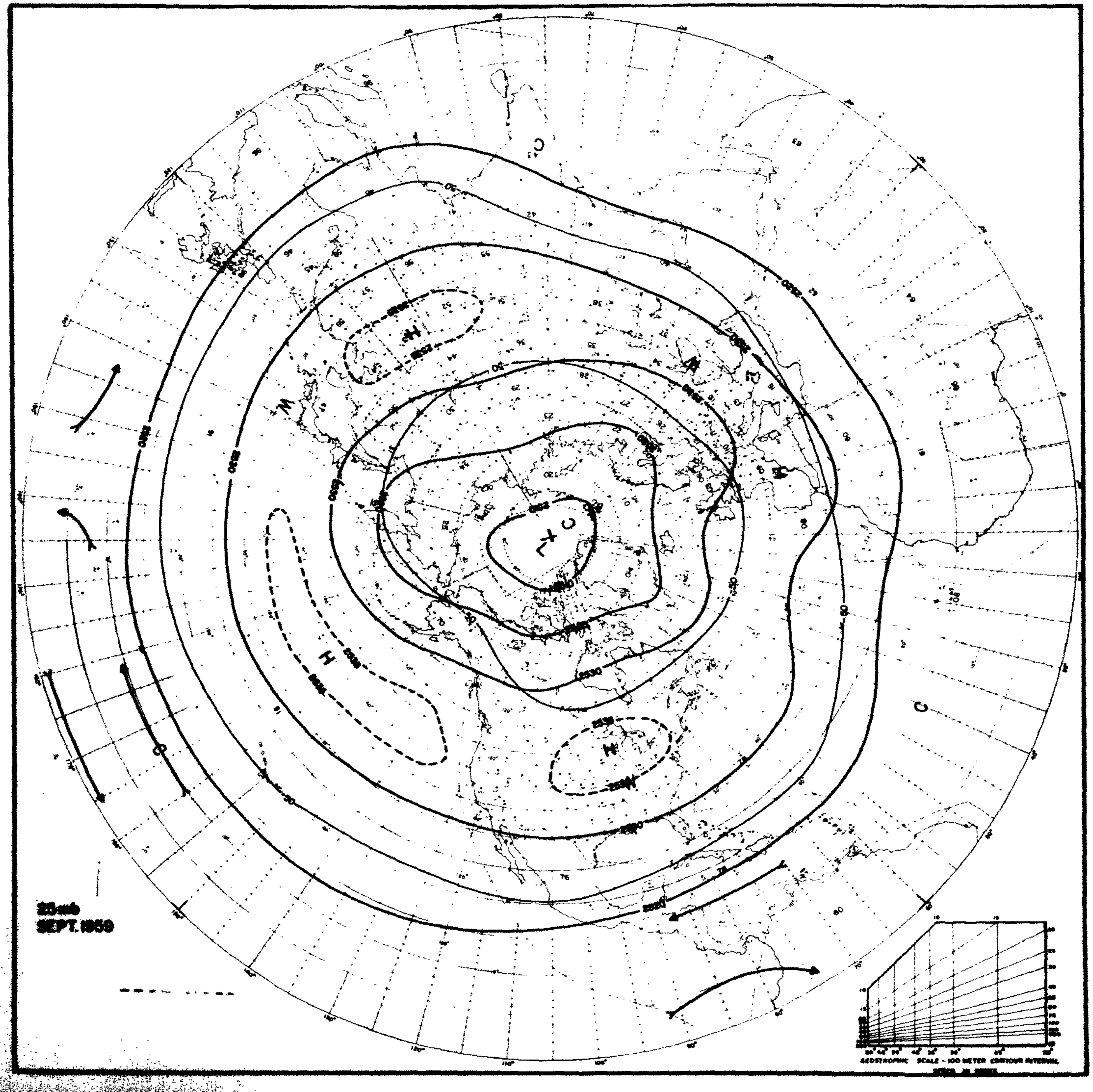


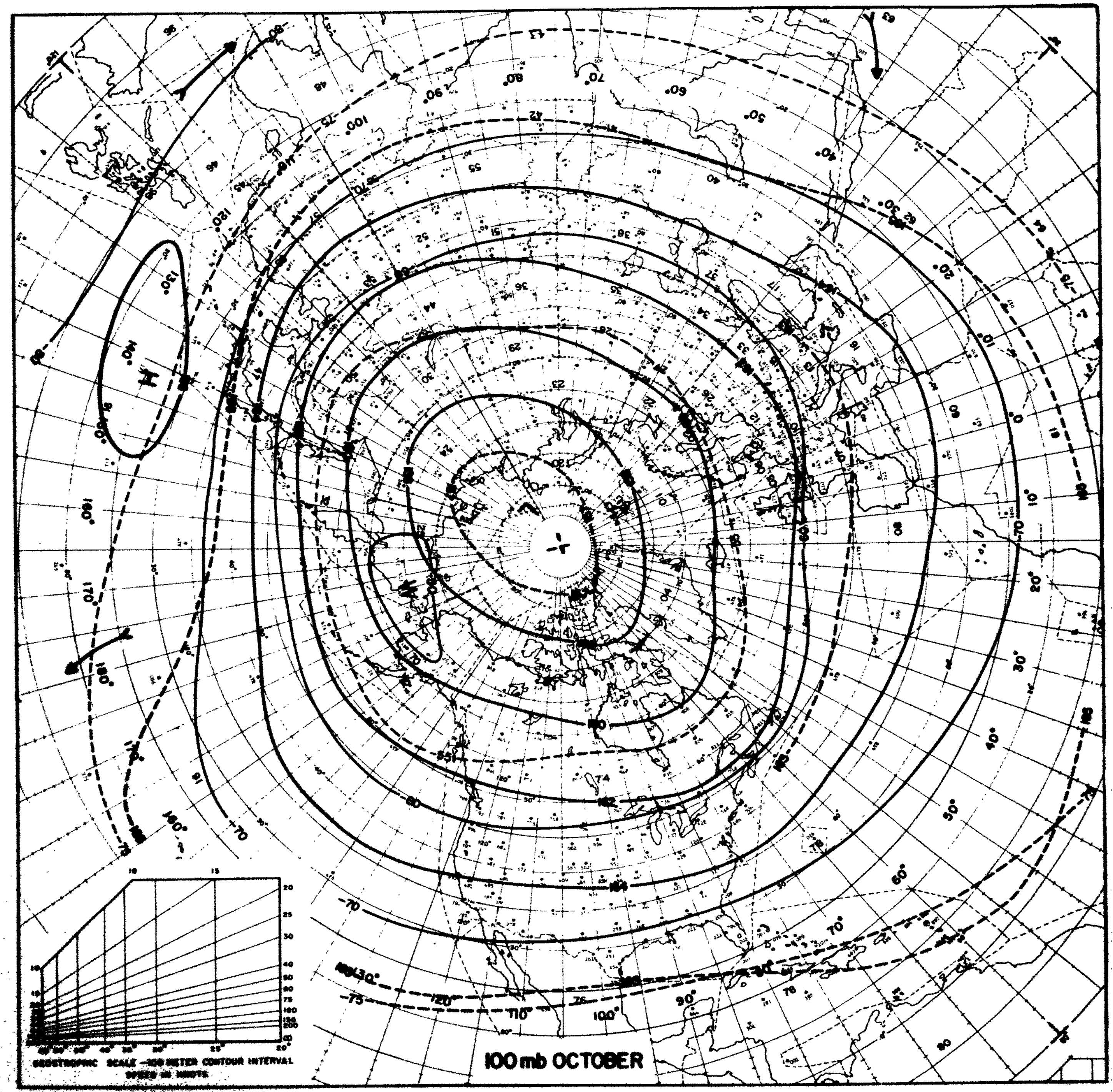
25mb SEPTEMBER
GEOSTROPHIC SCALE - 100-METER CONTOUR INTERVAL
SPEED IN KNOTS

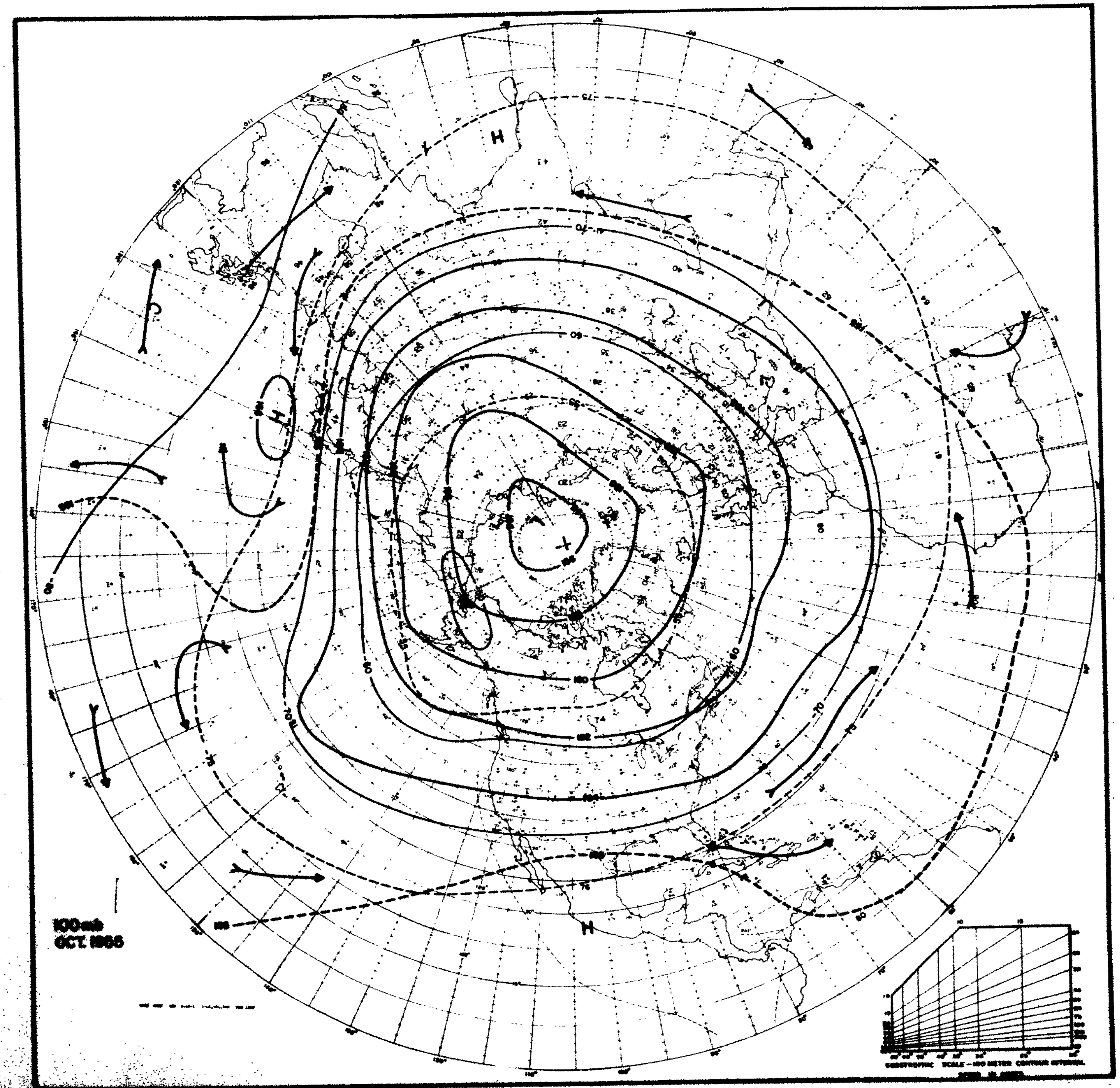

25mb
SEPT.1956
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

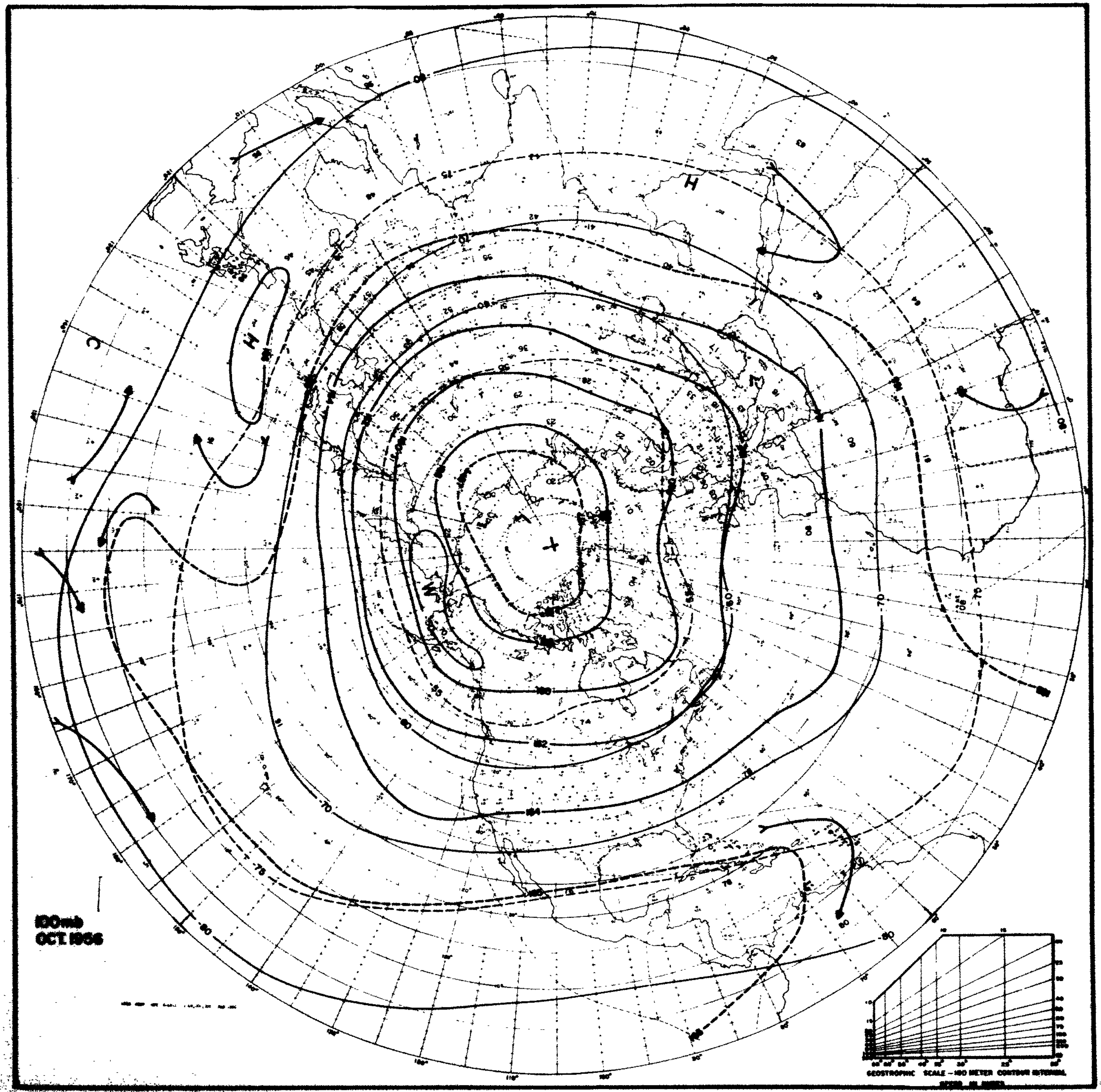

25 mb
SEPT. 1957

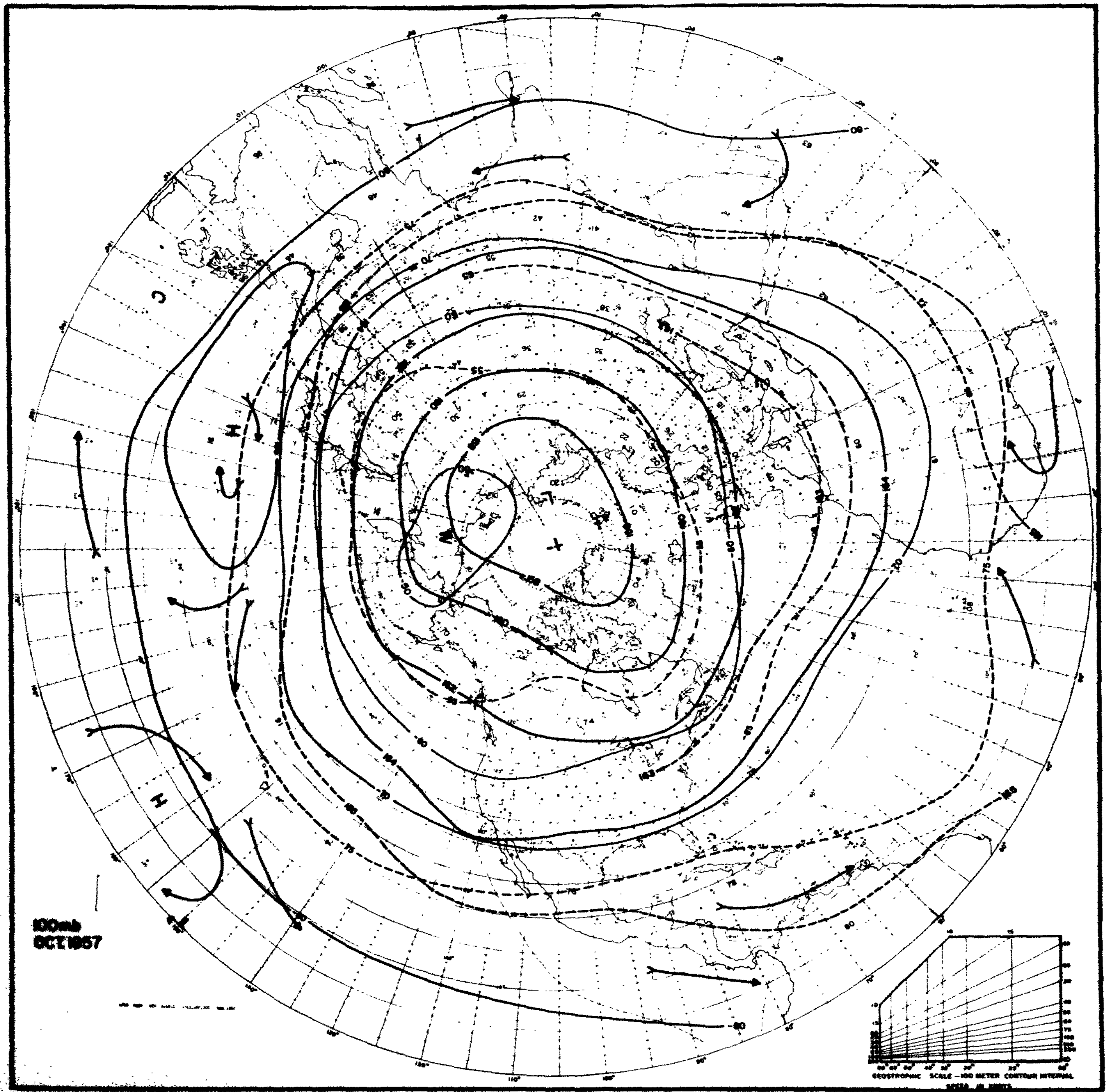

25 mb
SEPT 1958

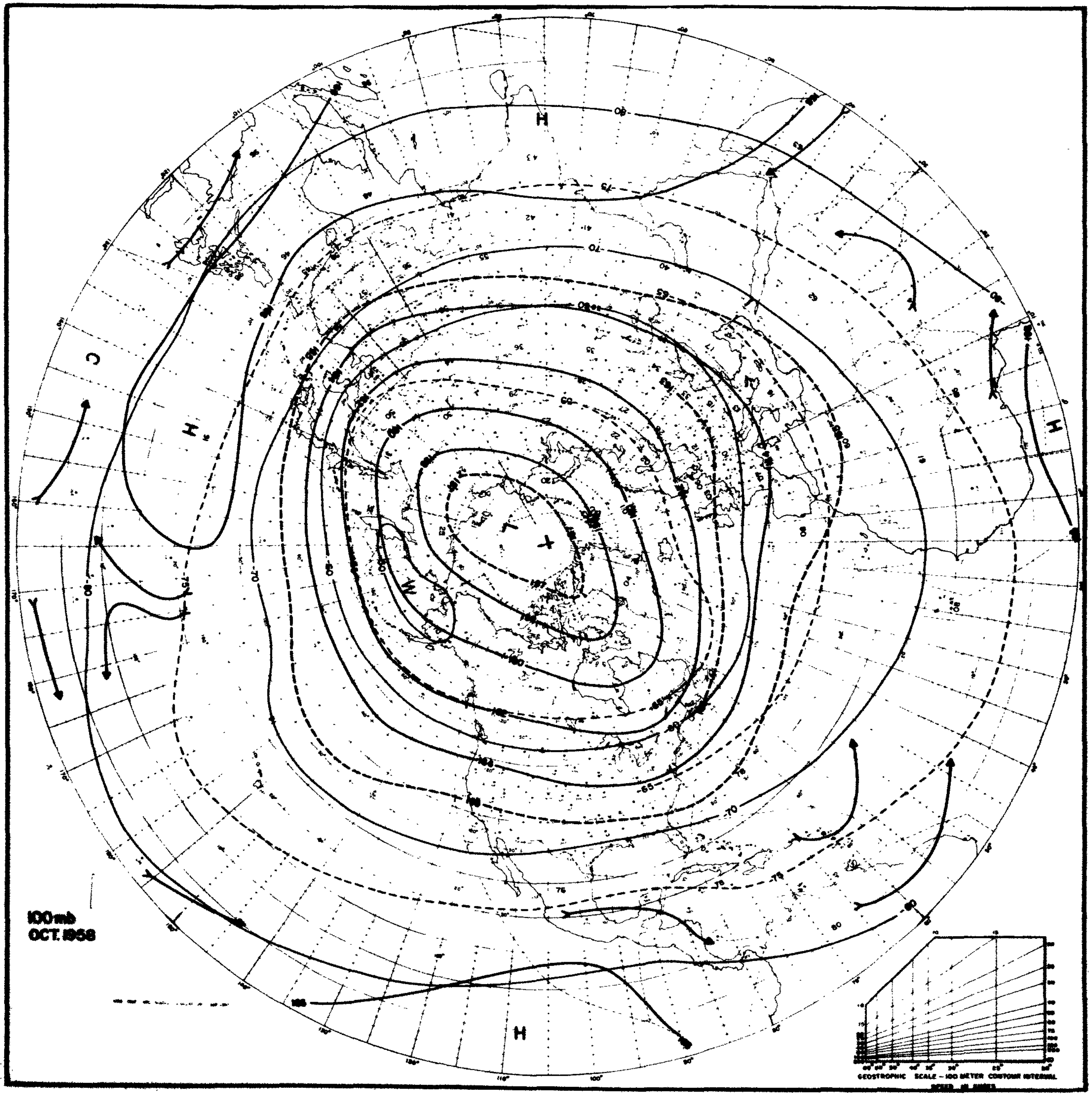

25 mb
SEPT. 1959
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL


GEOSTROPHIC SCALE —100 METER CONTOUR INTERVAL
SPEED IN KNOTS
100 mb OCTOBER

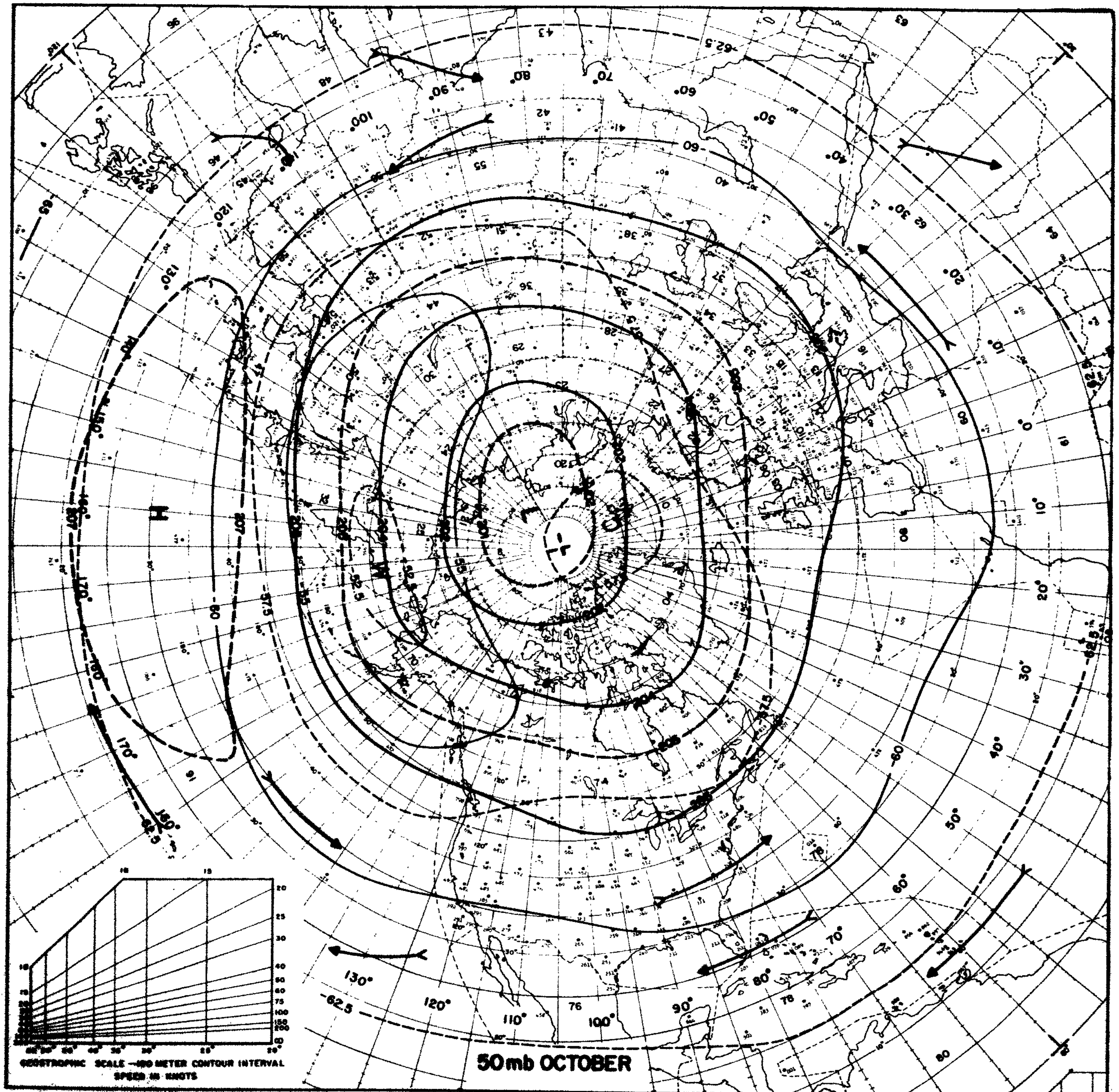

100mb
OCT. 1966


100mb
OCT. 1956

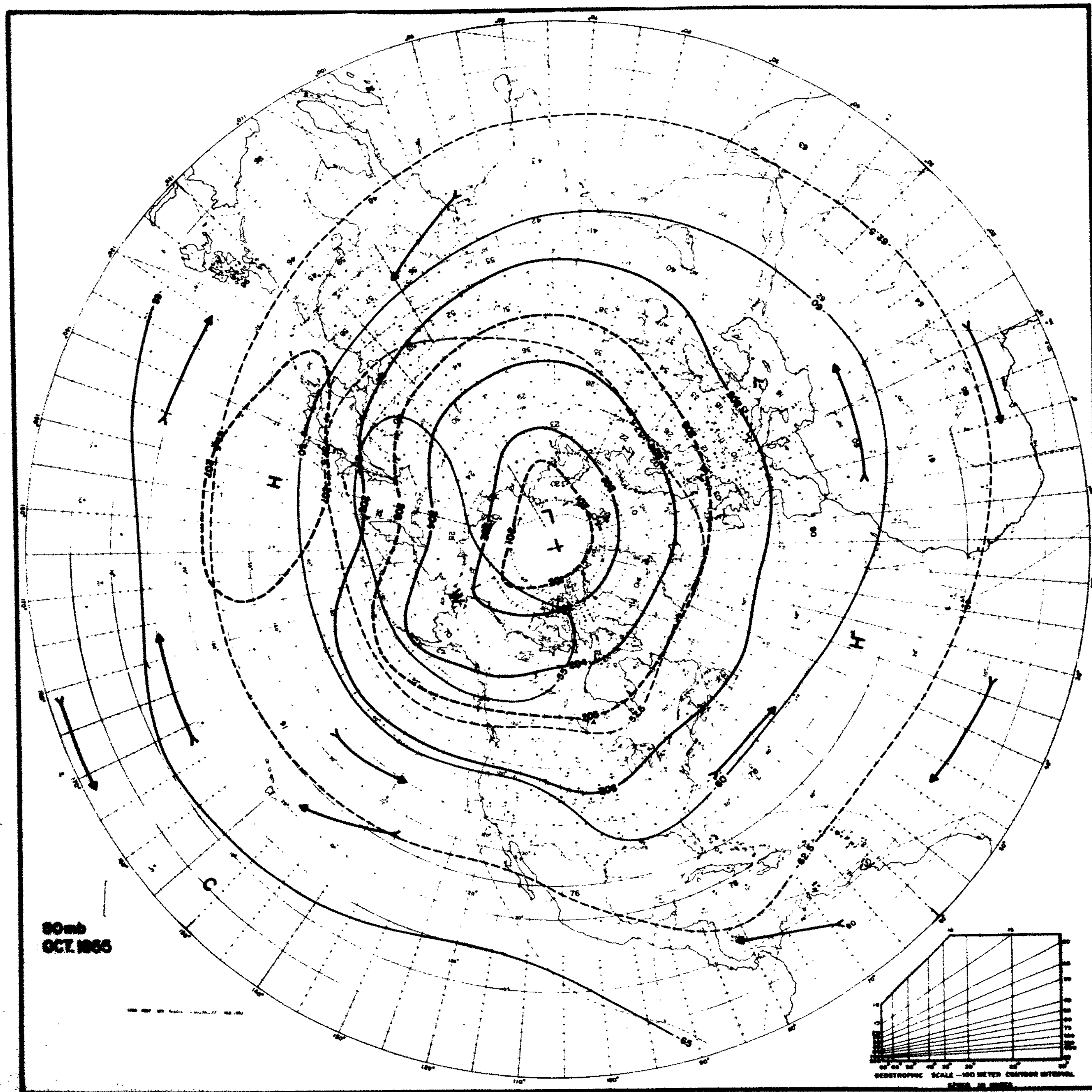

100mb
OCT 1957
GEOSTROPHIC SCALE – 100 METER CONTOUR INTERVAL
SPEED IN KNOTS
H
H
L
W
C

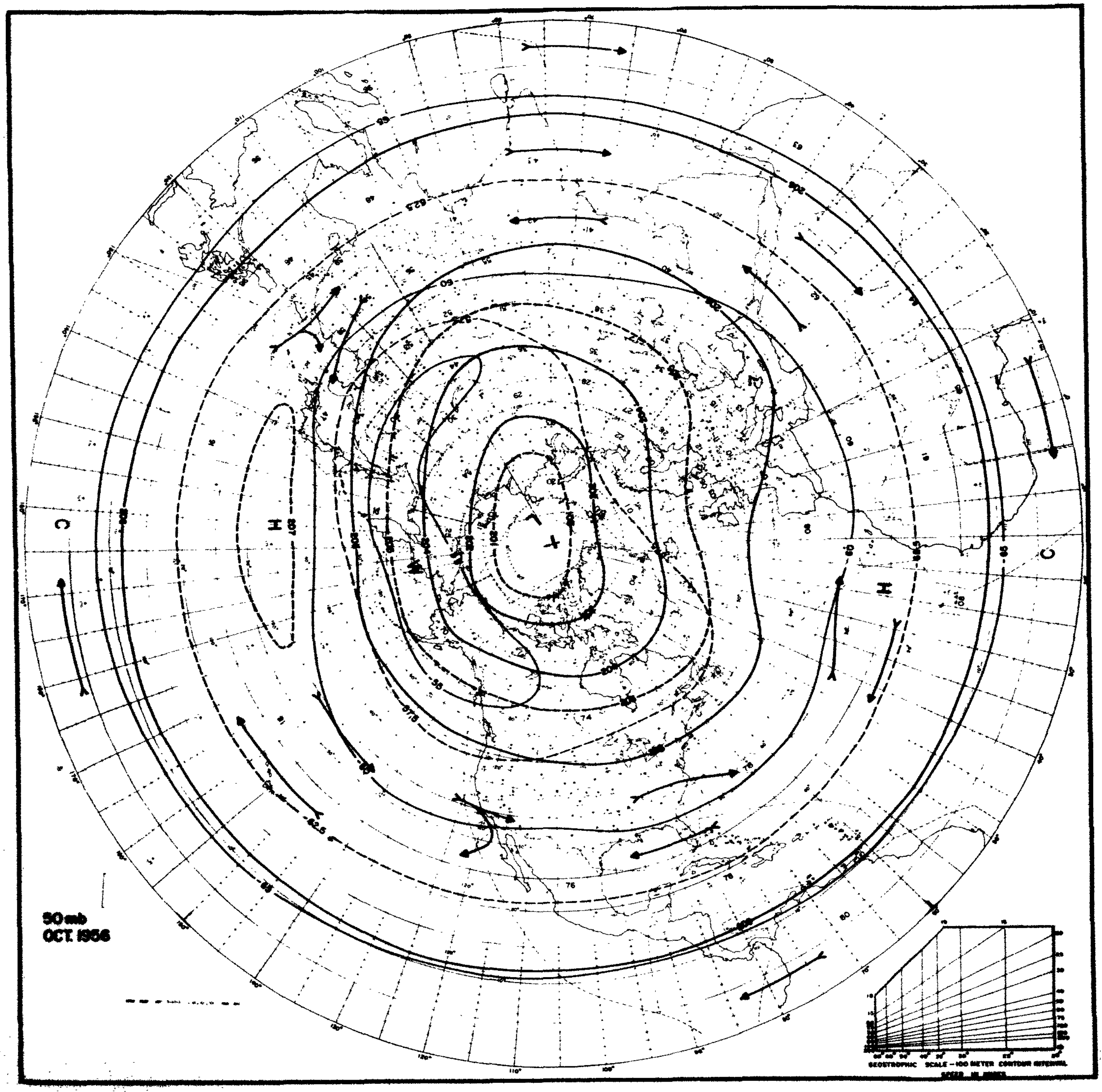


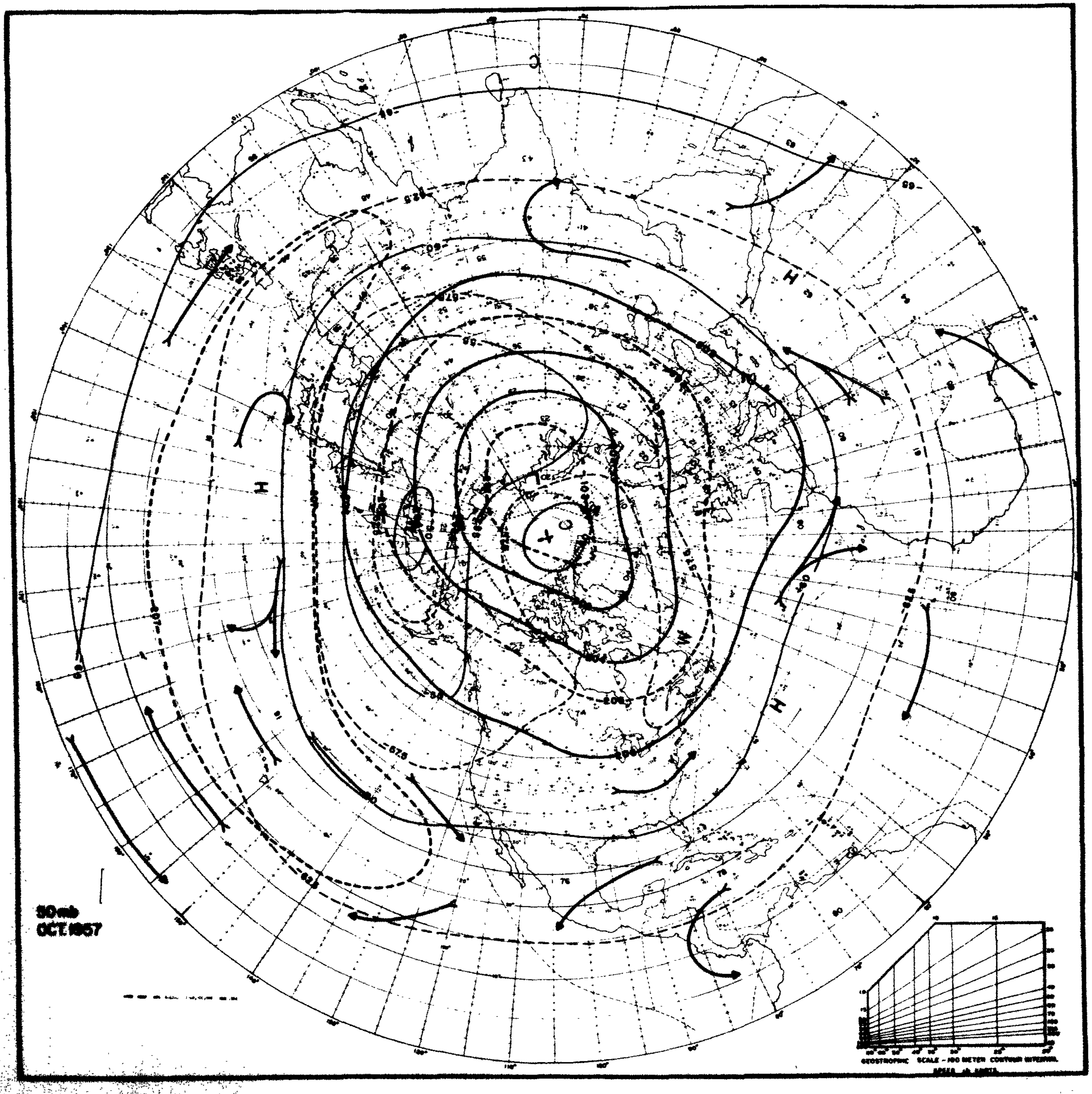
100 mb
OCT. 1958
H
H
H
H
L
W
C
-70
-75
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

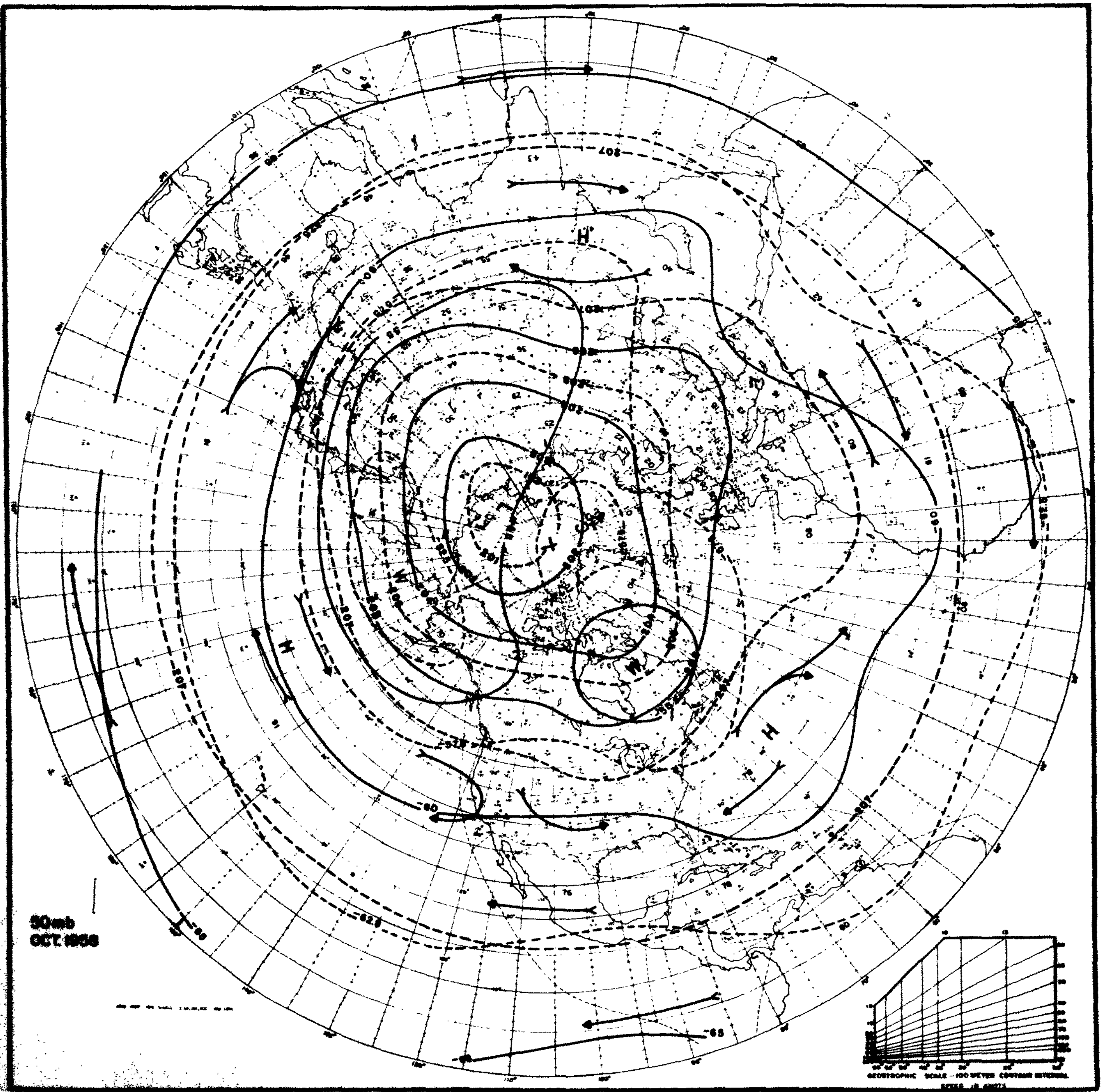


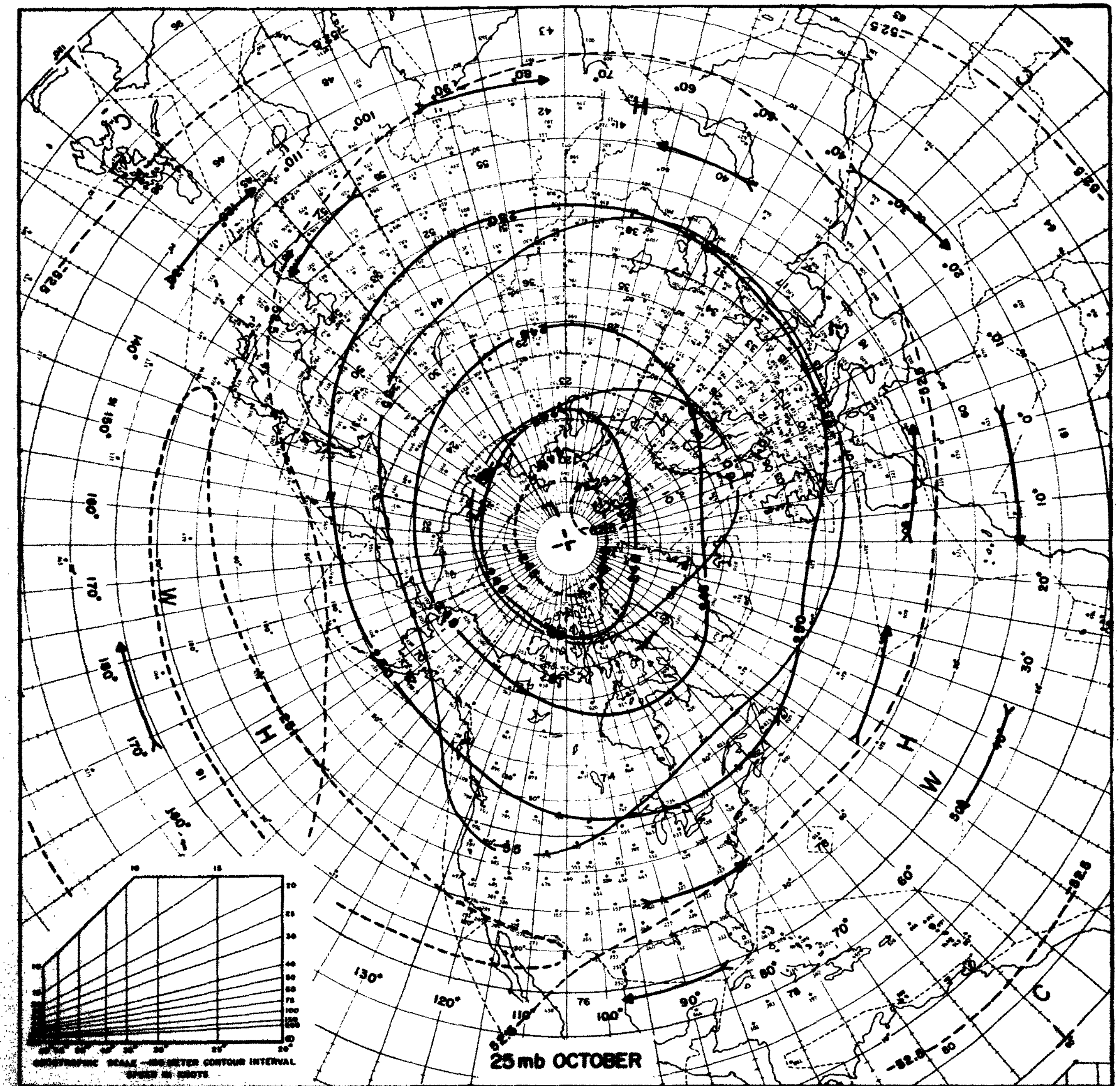
50mb OCTOBER
GEOSTROPHIC SCALE —160 METER CONTOUR INTERVAL
SPEED IN KNOTS


50mb
OCT. 1965
GEOSTROPHIC SCALE—100 METER CONTOUR INTERVAL

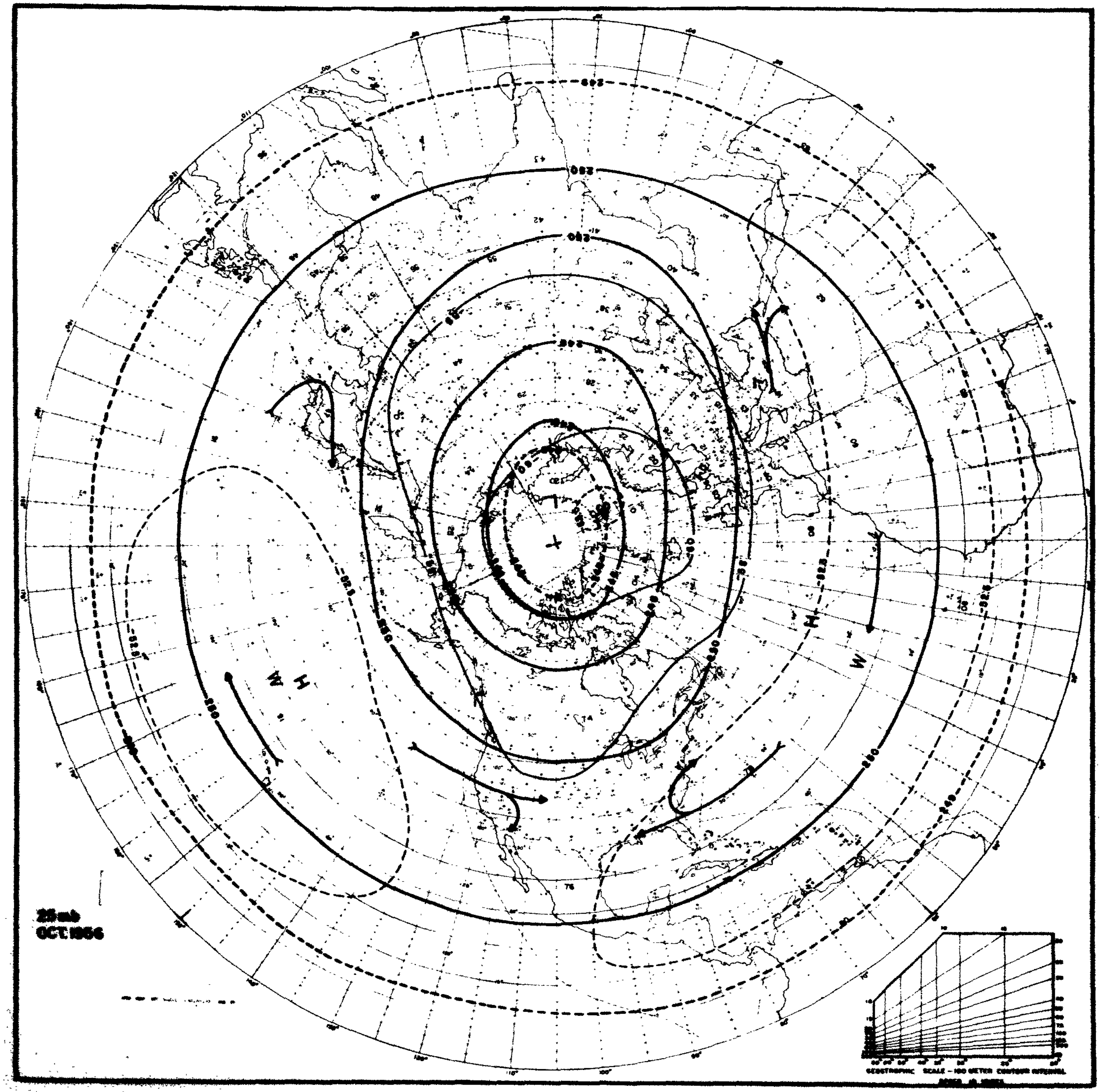

50 mb
OCT. 1956
GEOSTROPHIC SCALE — 100 METER CONTOUR INTERVAL


50 mb
OCT. 1957
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

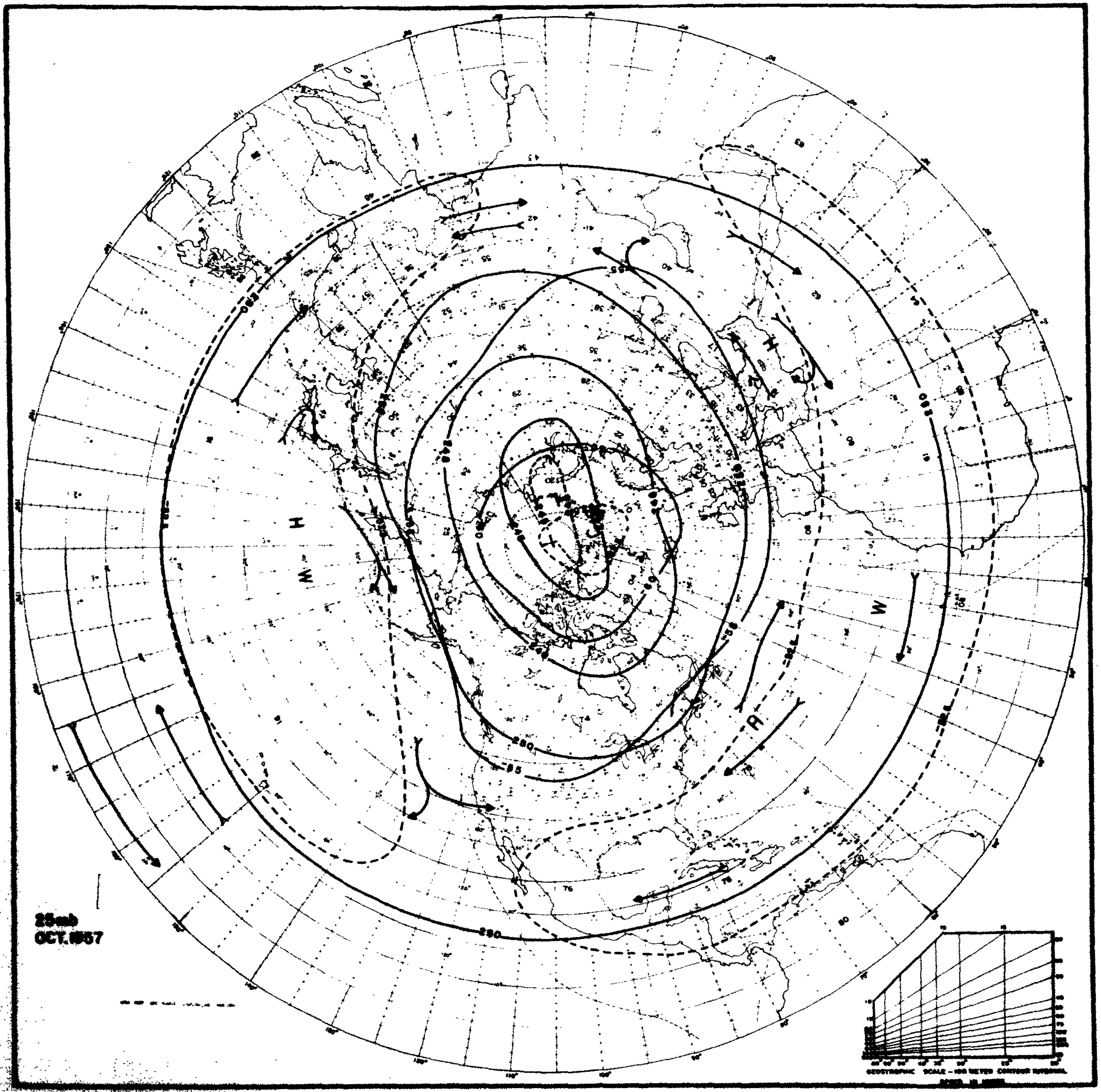

30mb
OCT. 1958
GEOSTROPHIC SCALE – 100 METER CONTOUR INTERVAL



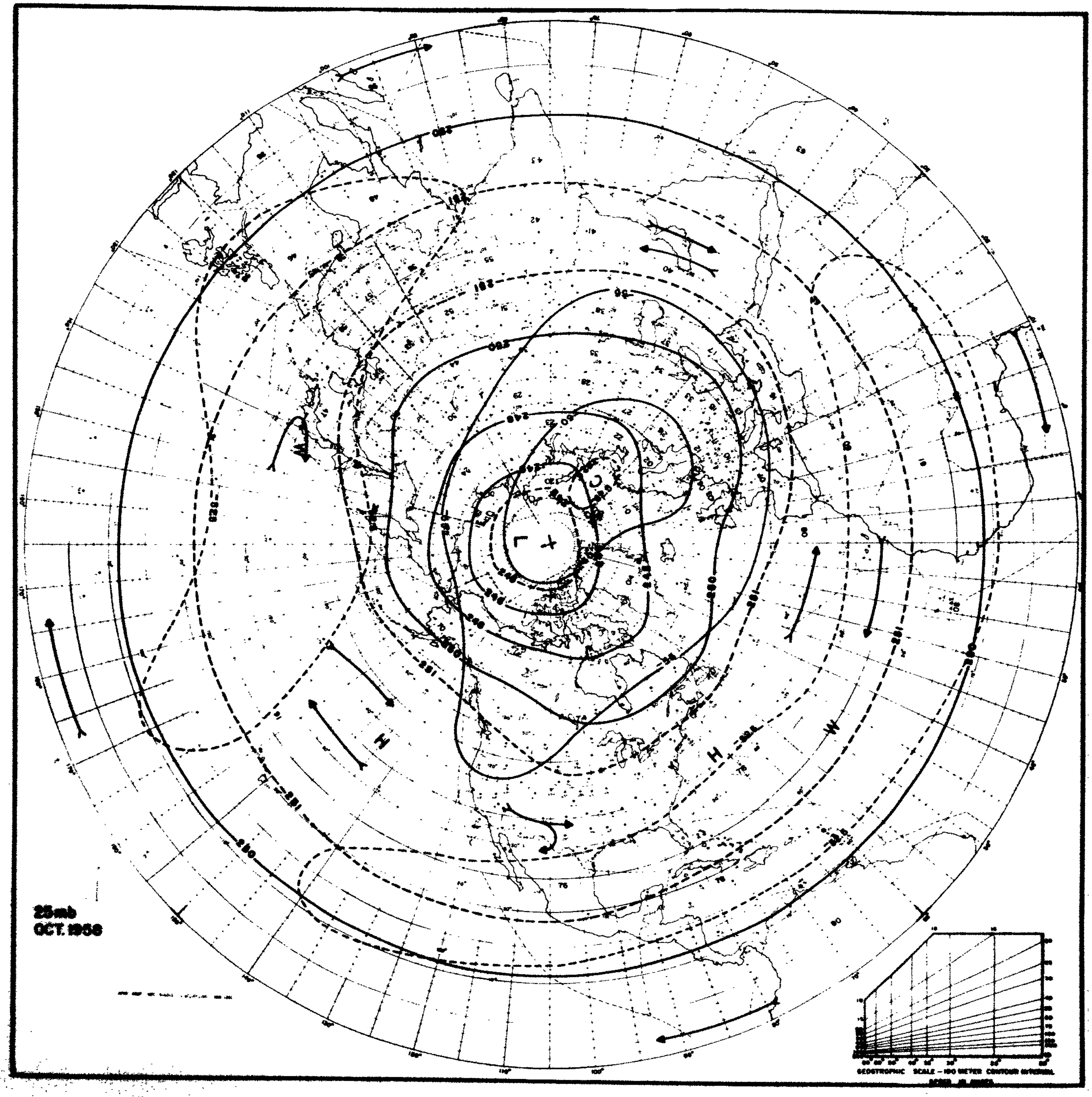
25 mb OCTOBER
GEOSTROPHIC SCALE — 160-METER CONTOUR INTERVAL
SPEED IN KNOTS

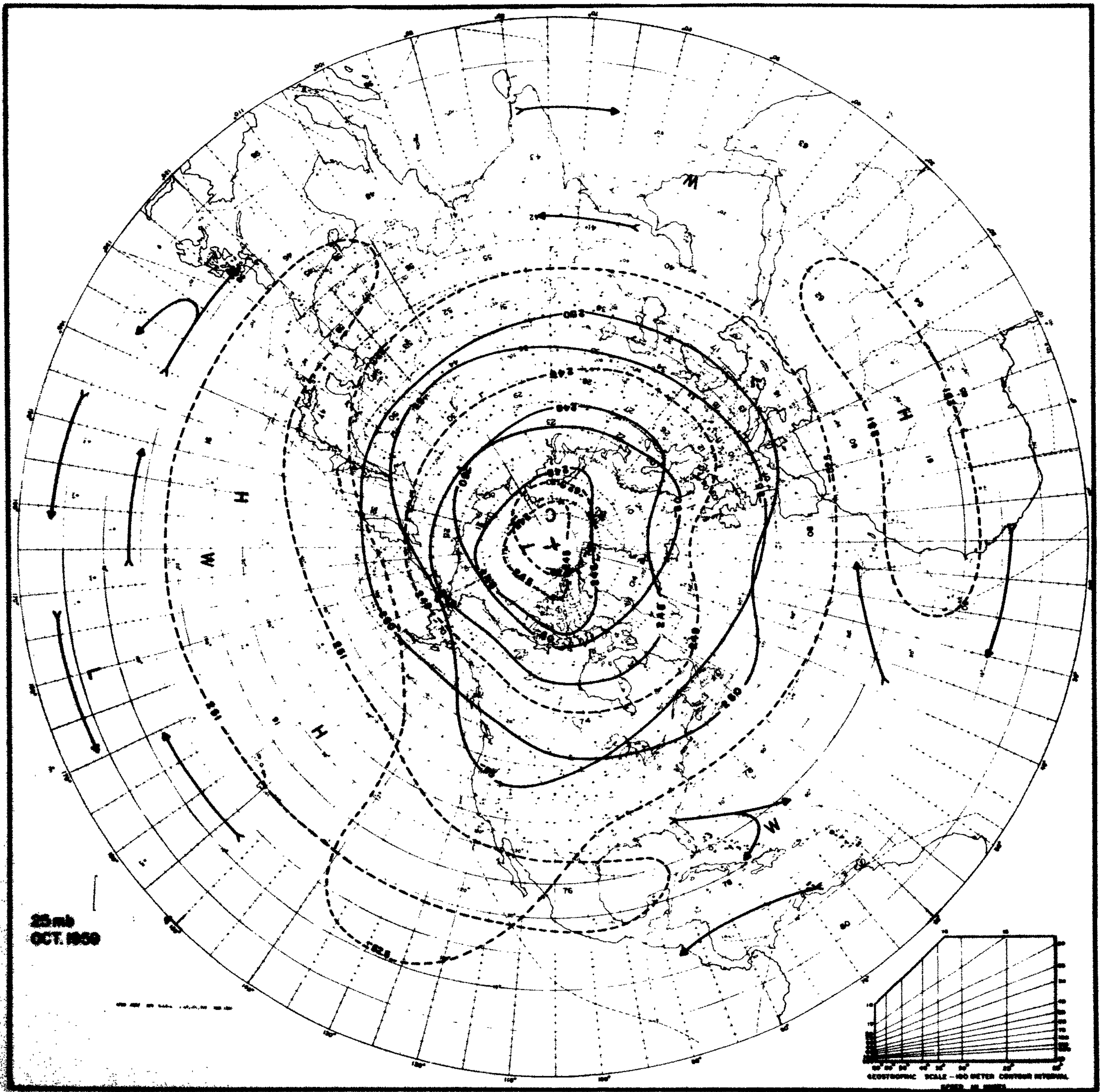


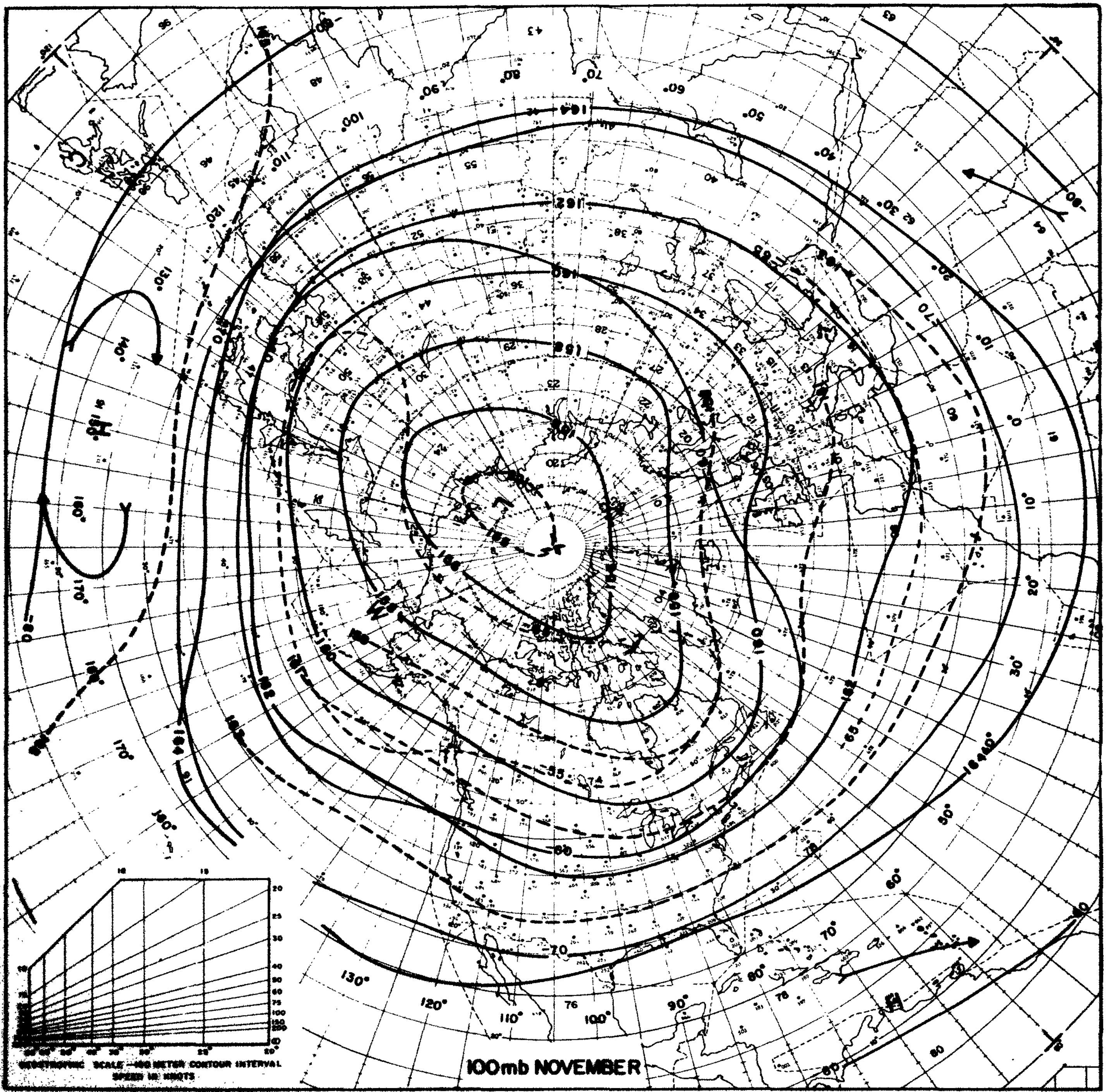
25 mb
OCT. 1956
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
H
W
H
W



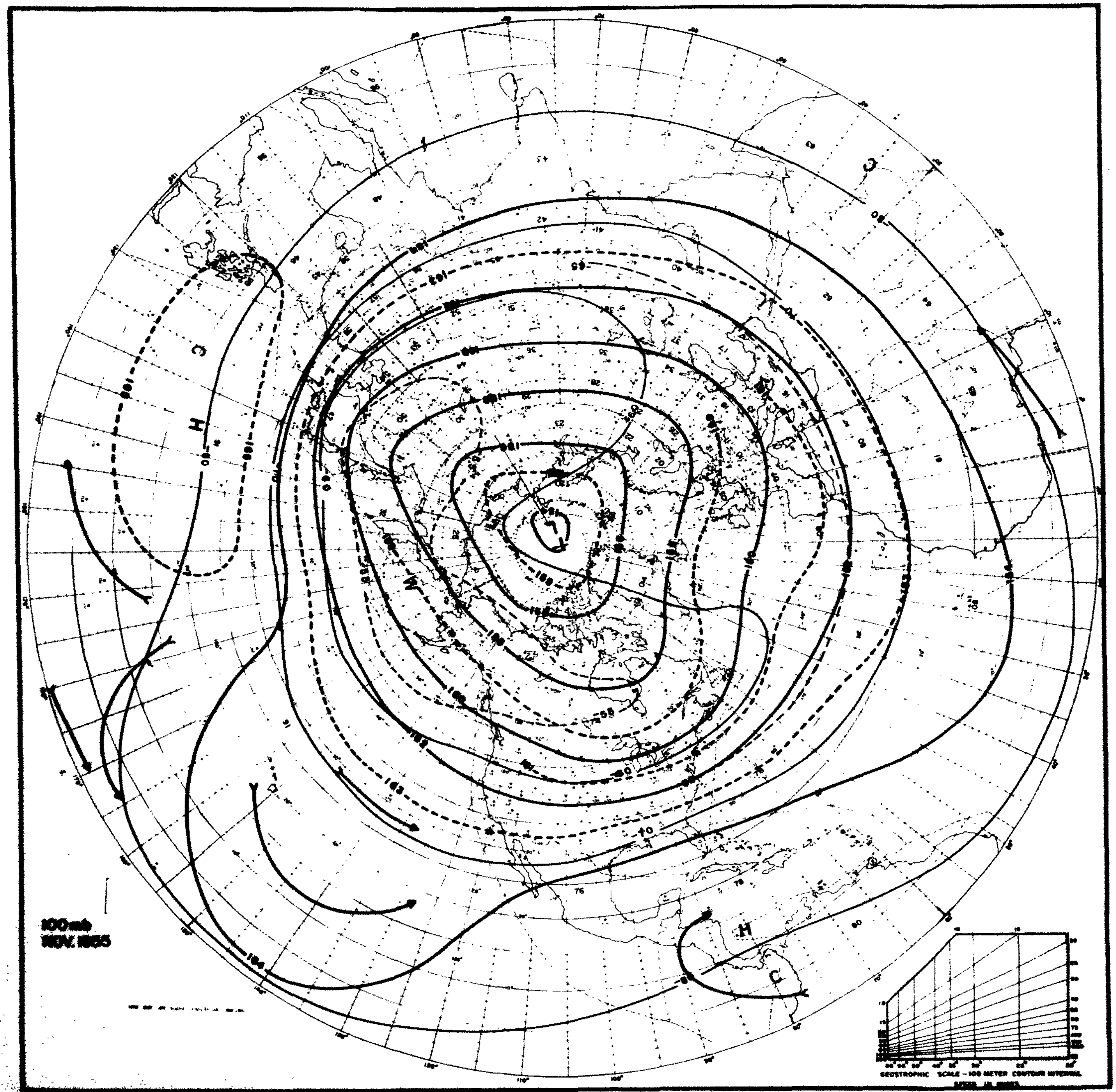
25mb
OCT. 1957
GEOSTROPHIC SCALE — 100 METER CONTOUR INTERVAL
H
W
H
W
R
280
260
240

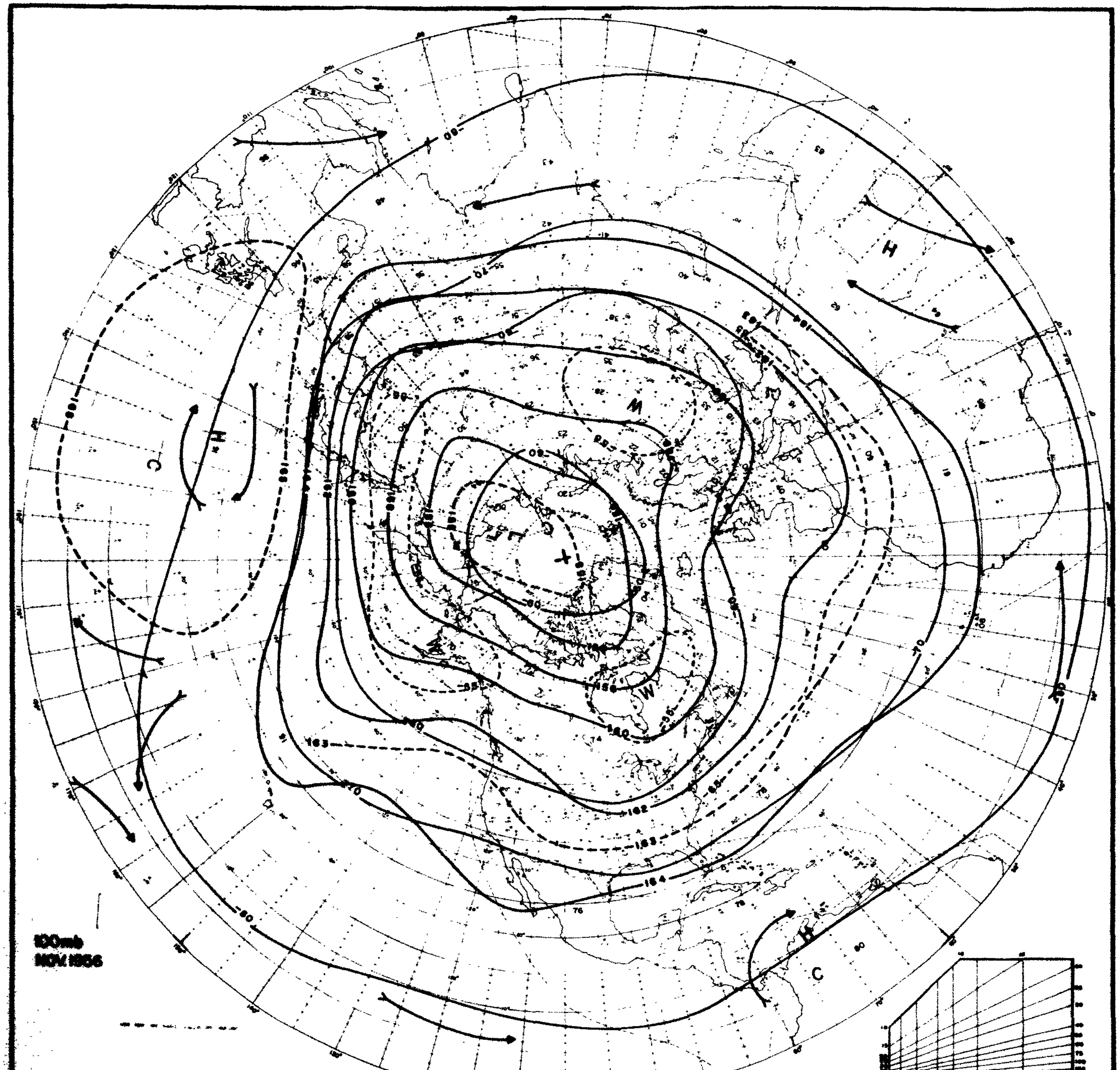

25mb
OCT. 1958
GEOSTROPHIC SCALE – 160 METER CONTOUR INTERVAL


25mb
OCT. 1959

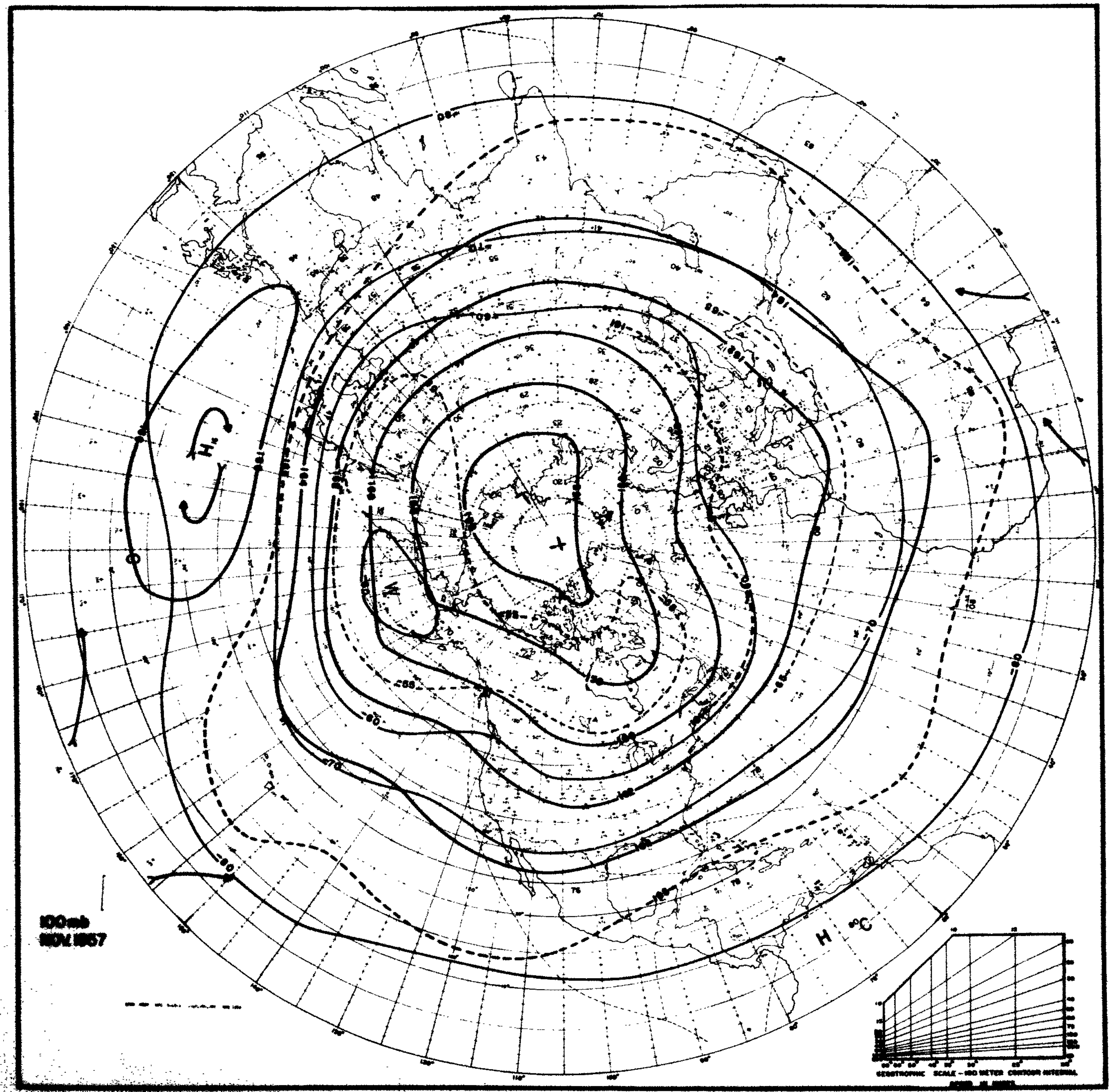


100mb NOVEMBER
GEOSTROPHIC SCALE—160 METER CONTOUR INTERVAL
SPEED IN KNOTS

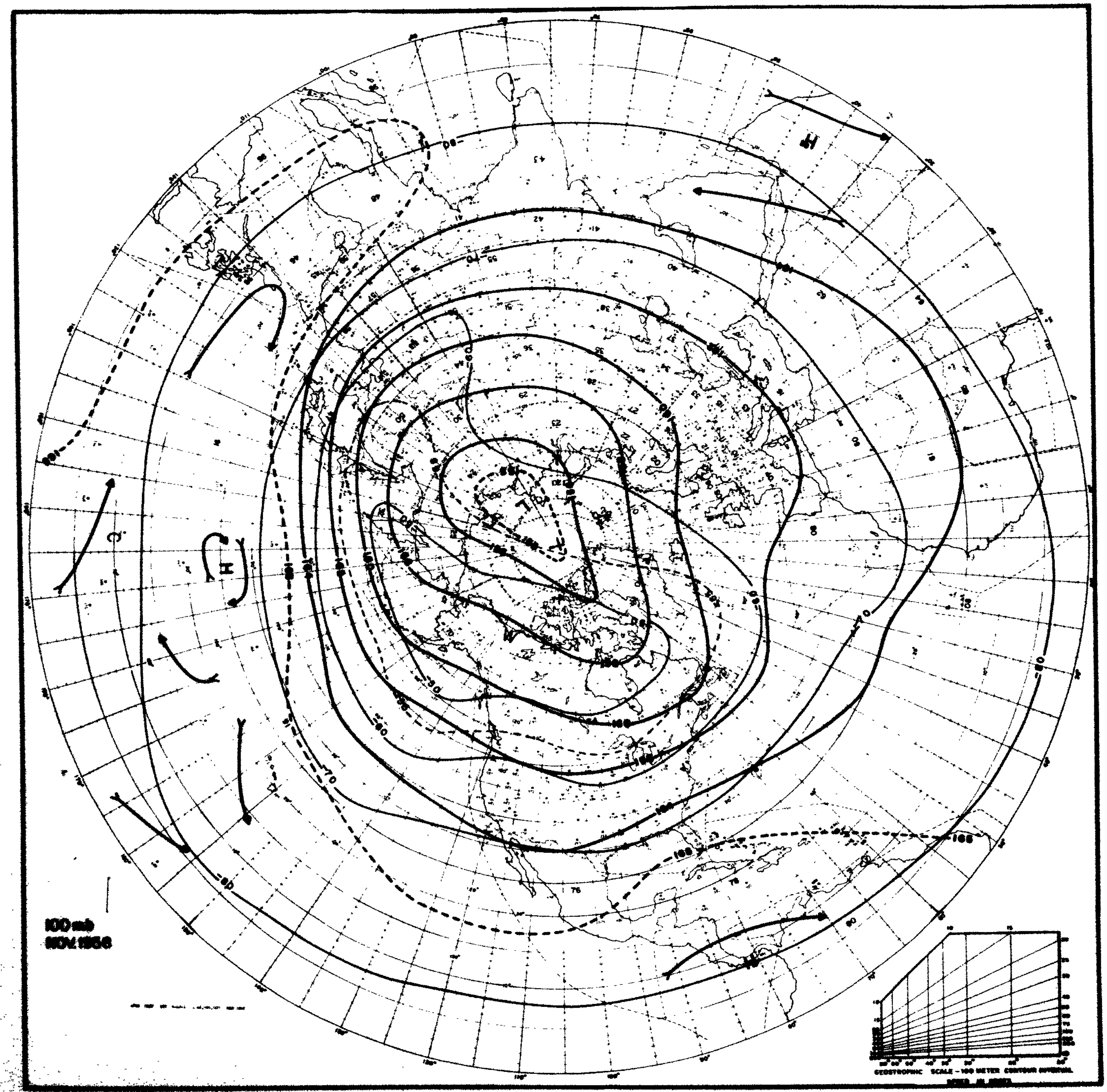

100 mb
NOV. 1955
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

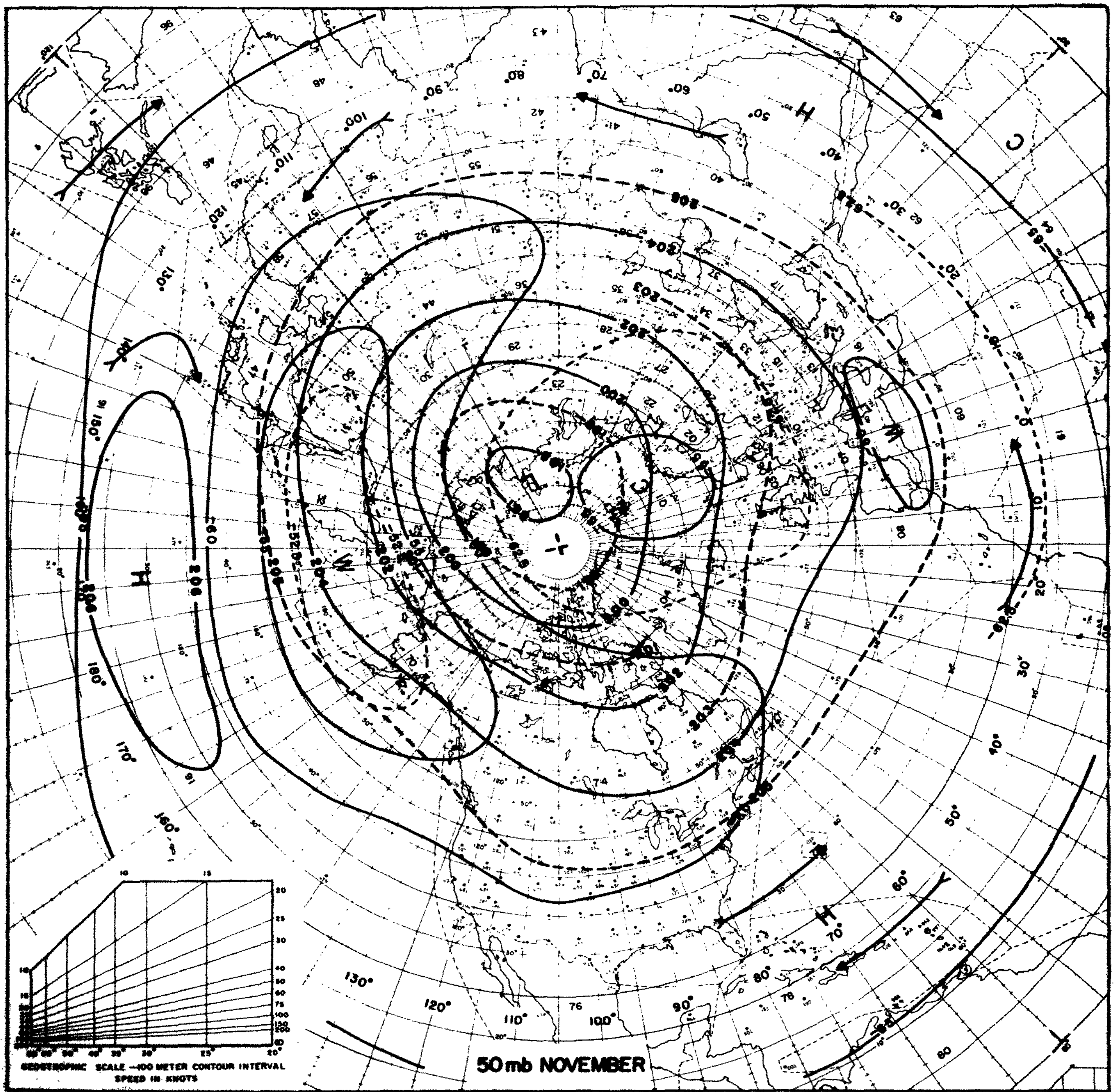


100mb
NOV. 1956
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

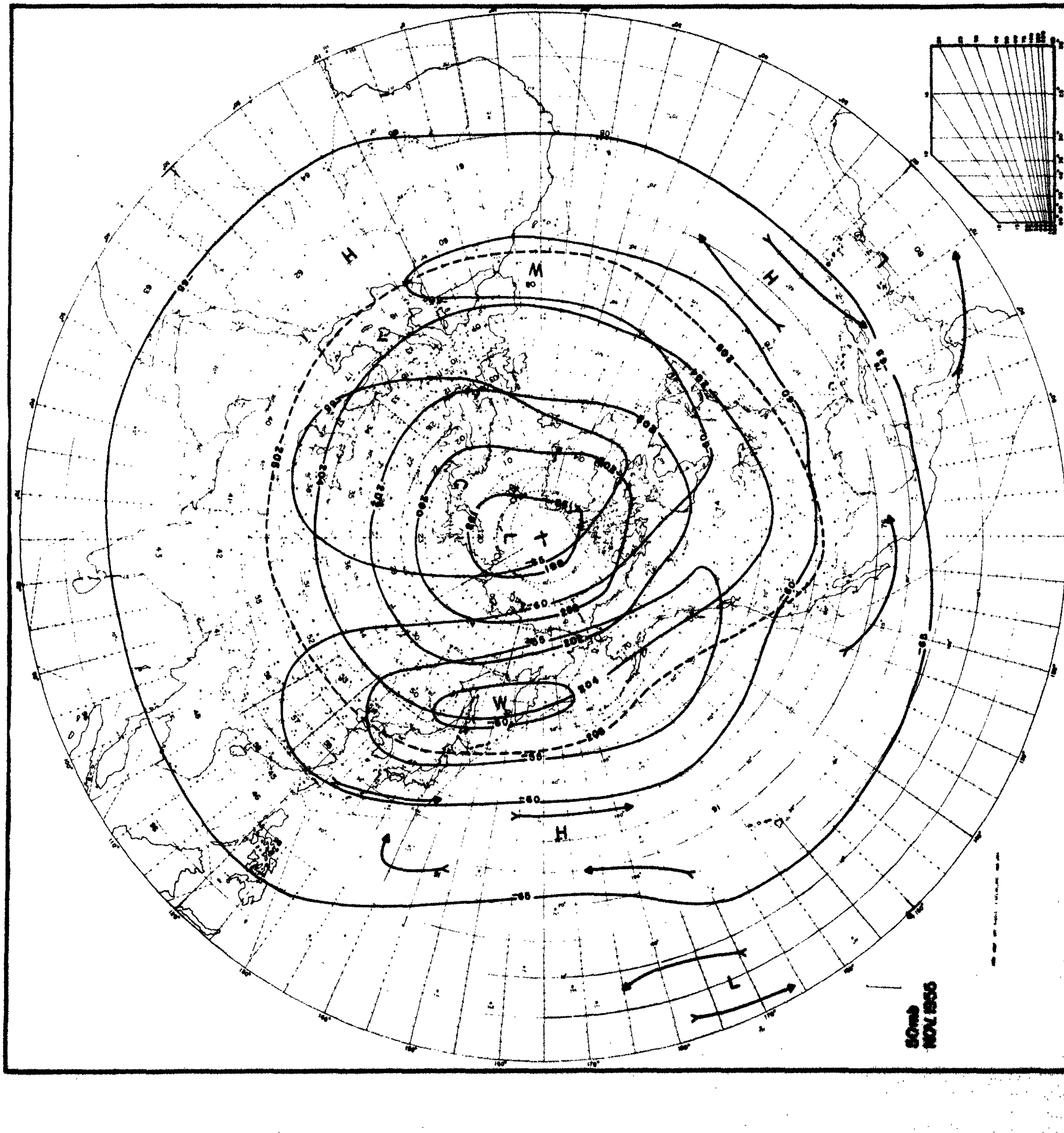


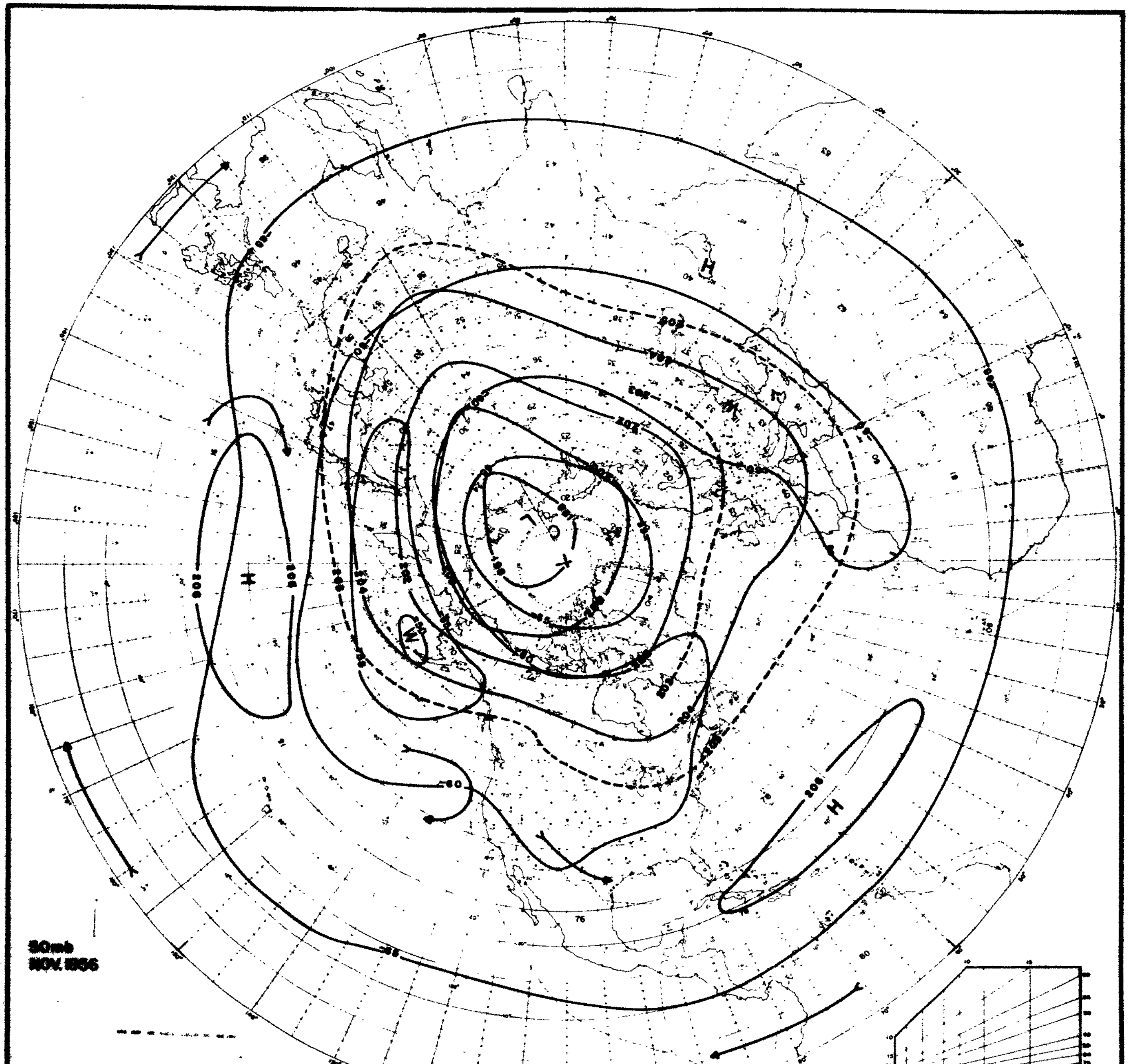
100mb
NOV. 1957
H
°C
GEOSTROPHIC SCALE - 160 METER CONTOUR INTERVAL


100 mb
NOV. 1956
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

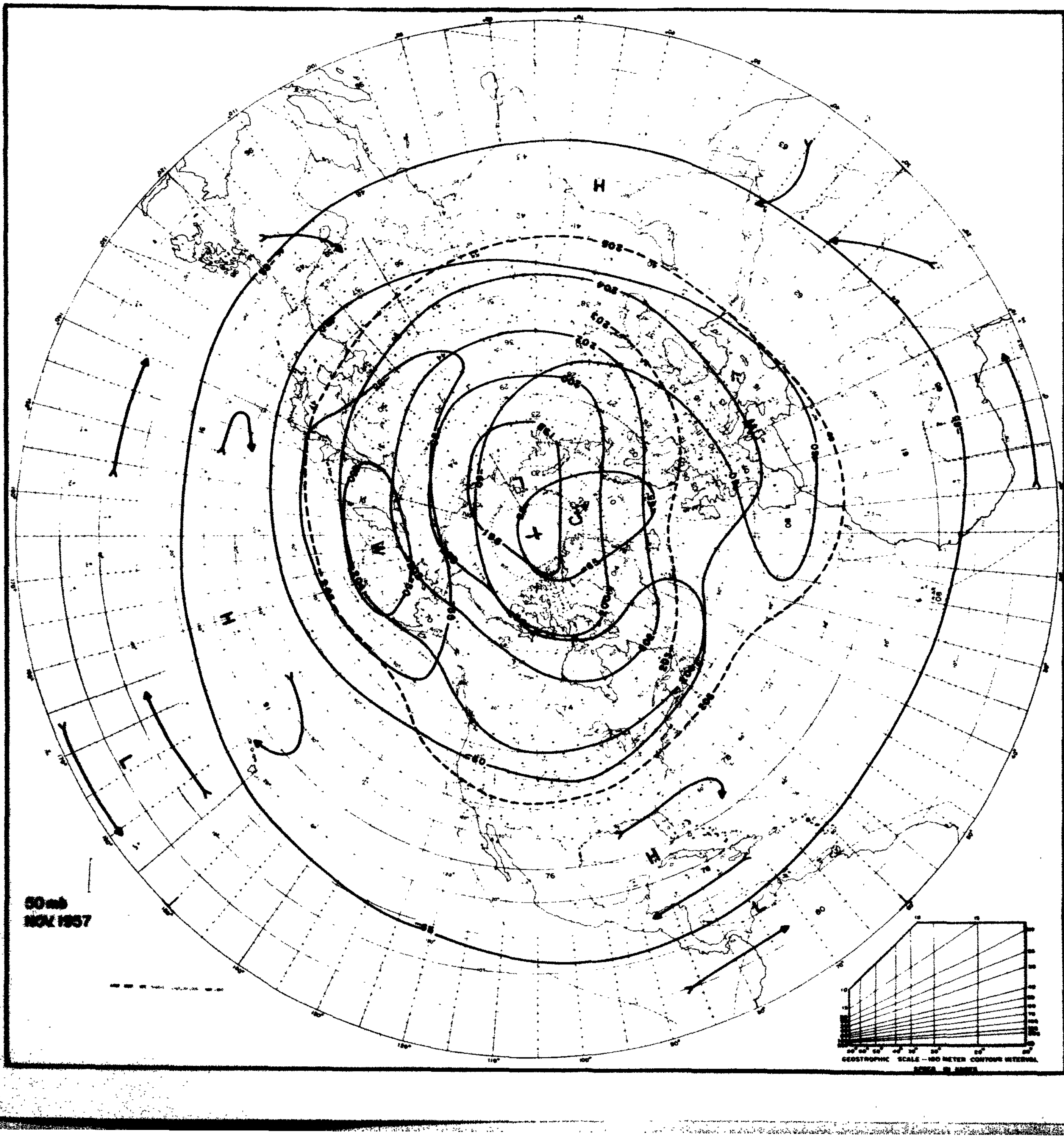


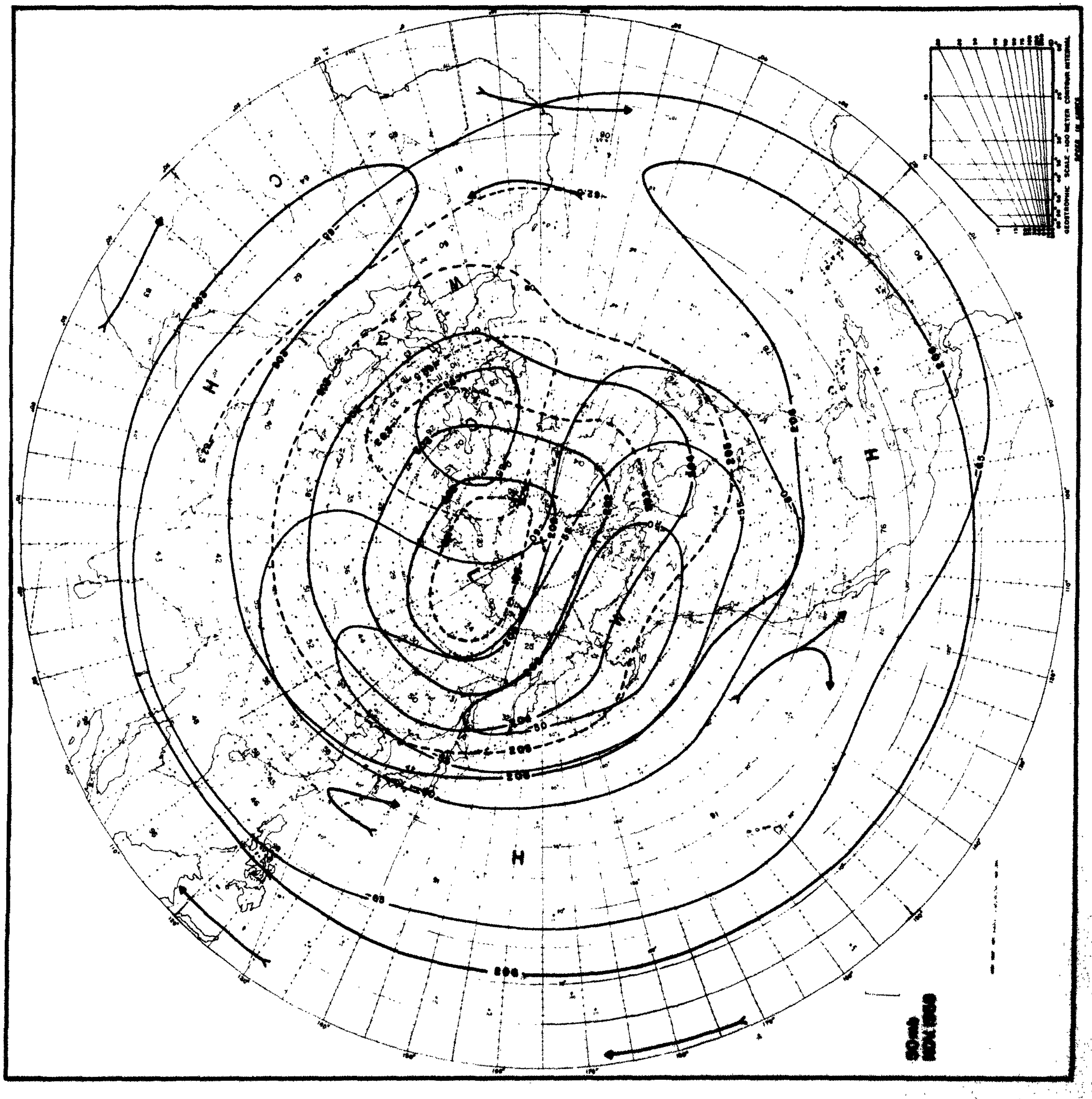
50 mb NOVEMBER

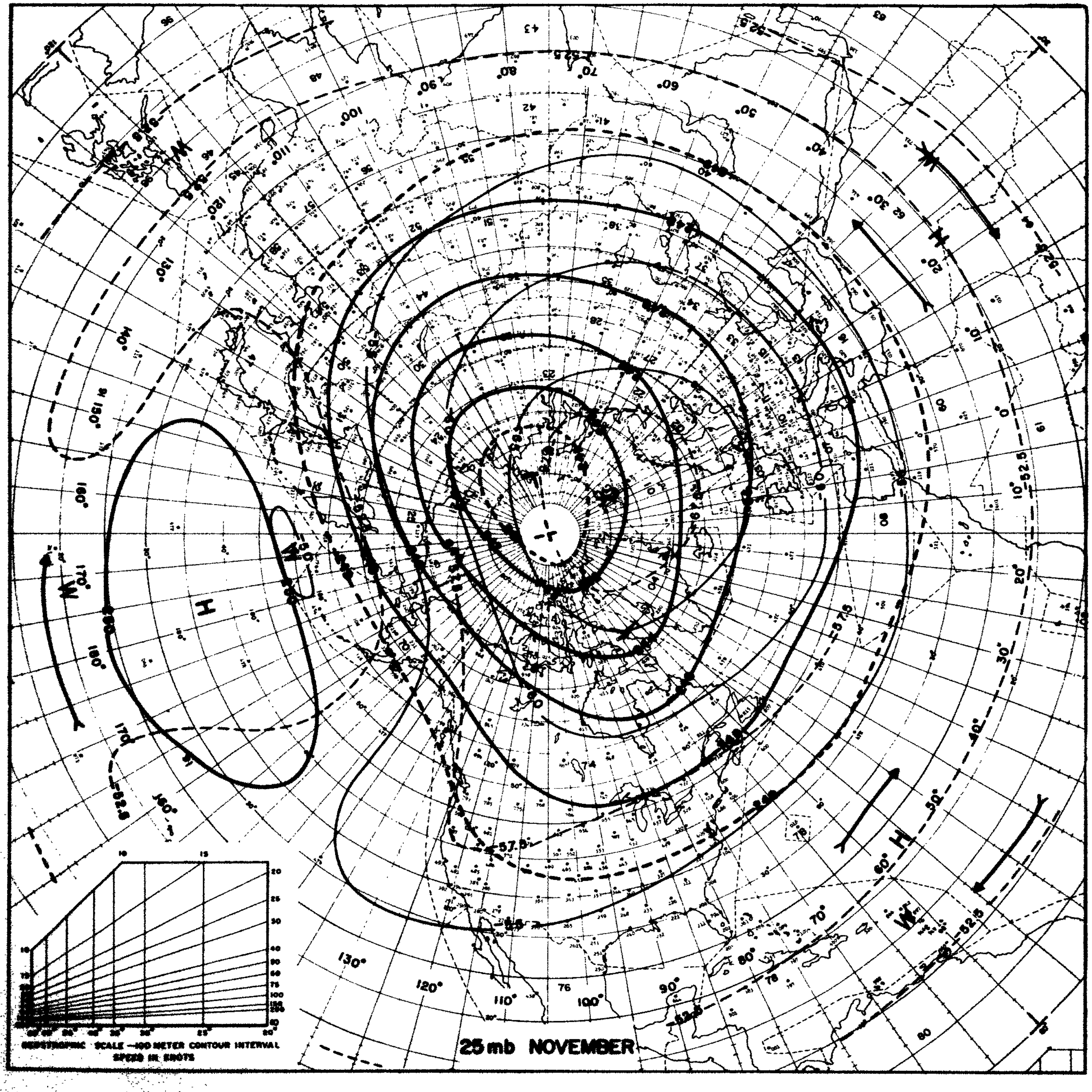

50mb
NOV 1956

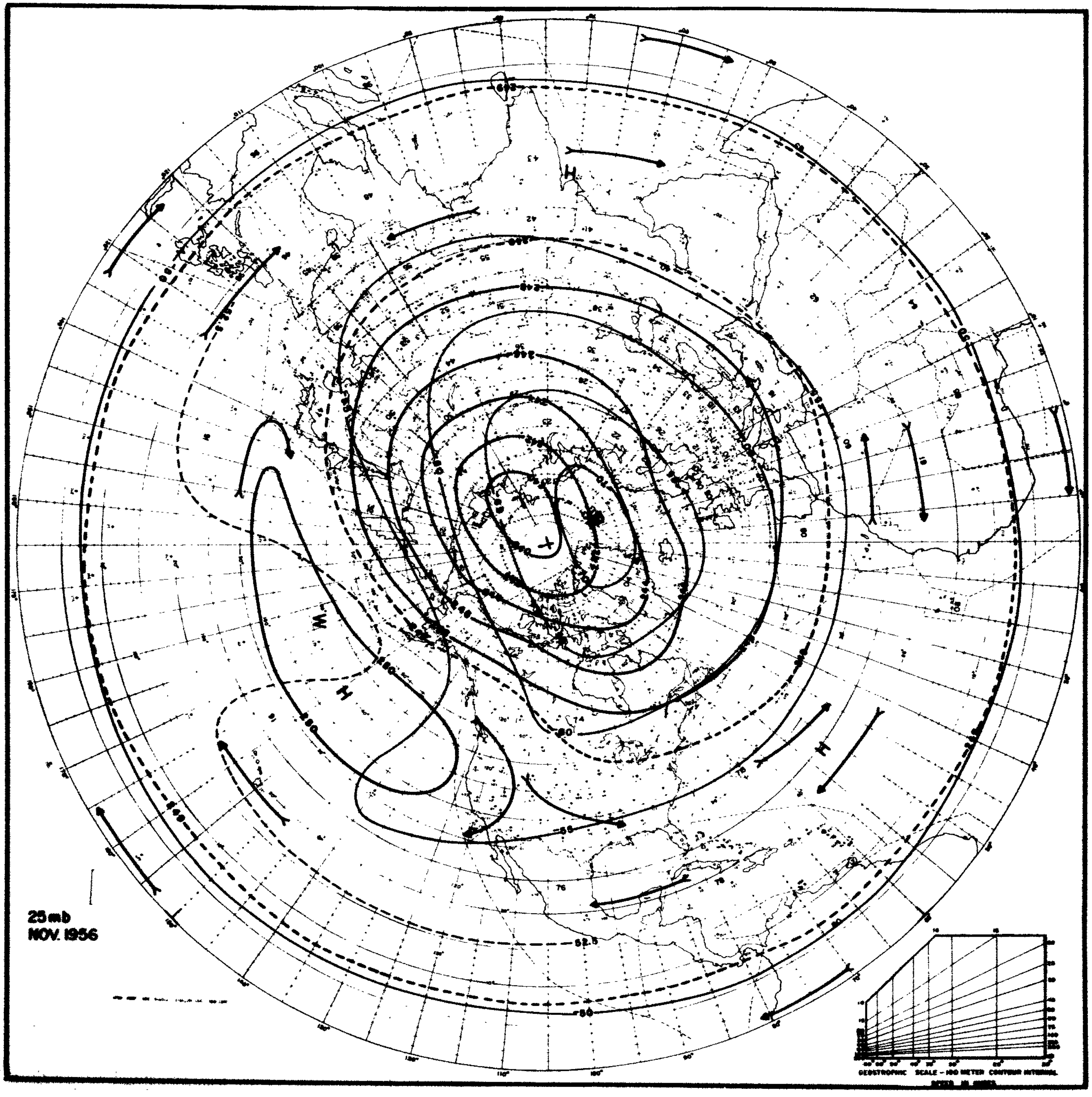


50mb
NOV. 1966
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

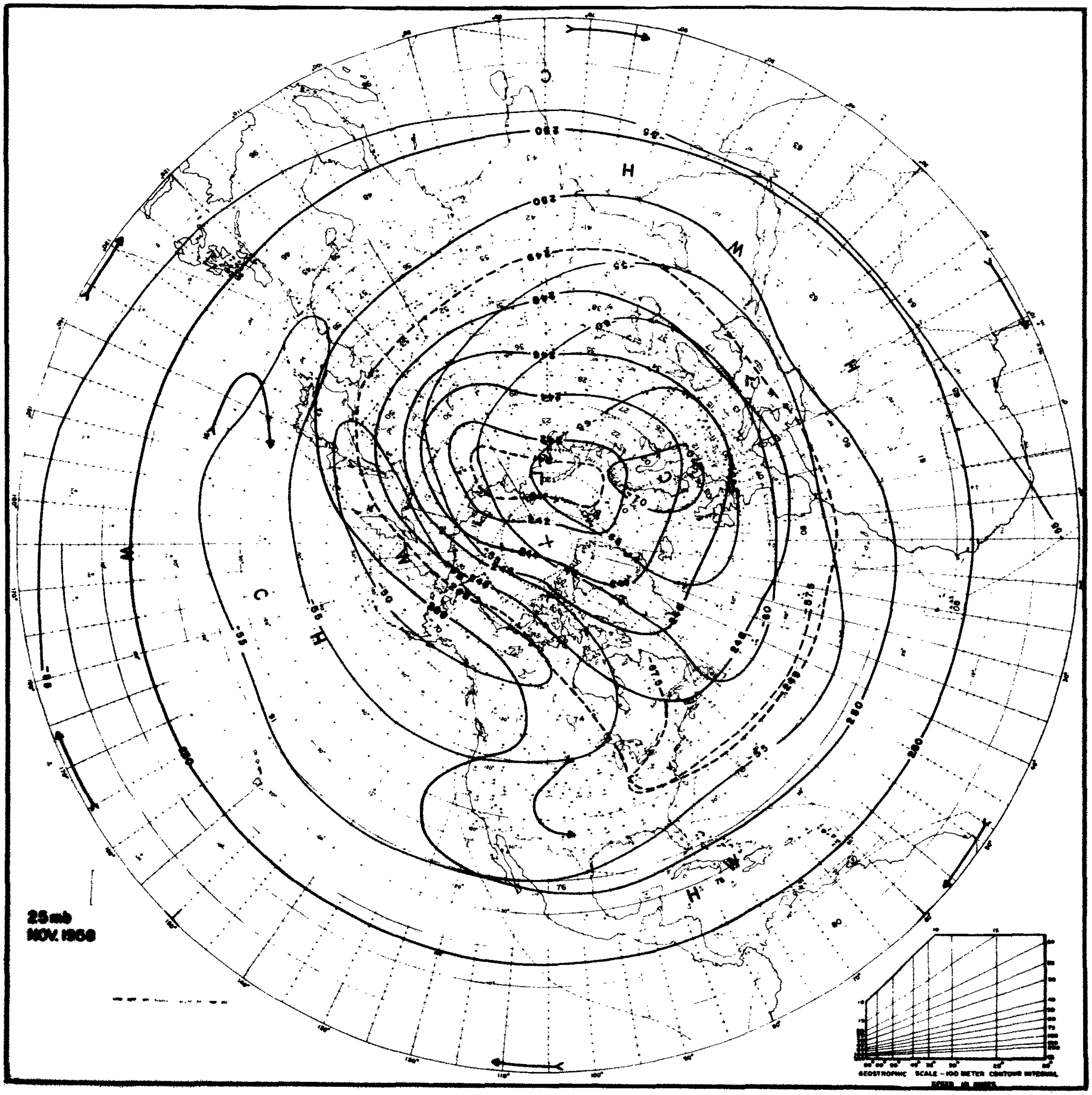

50 mb
NOV 1957
GEOSTROPHIC SCALE – 100 METER CONTOUR INTERVAL

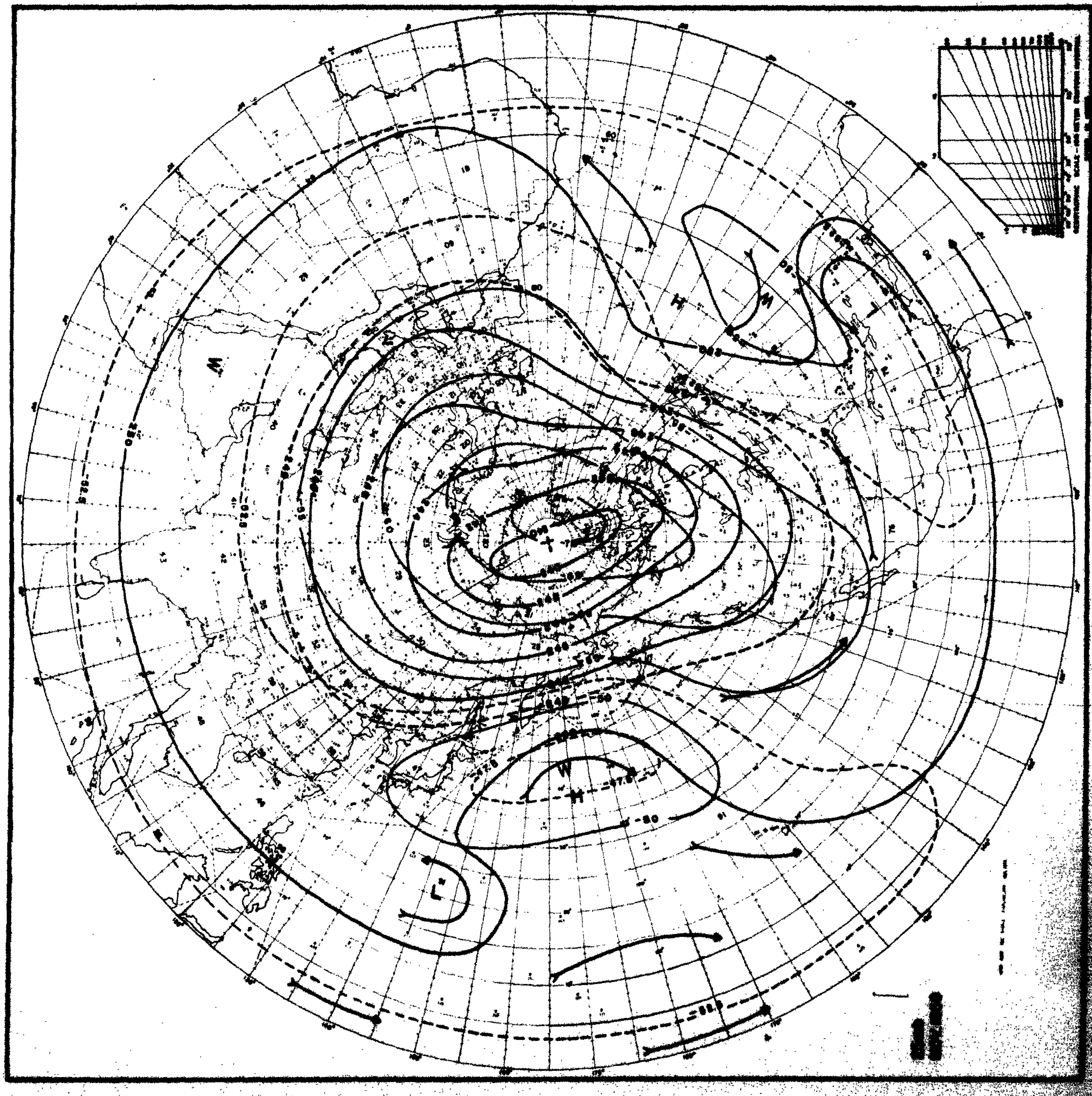


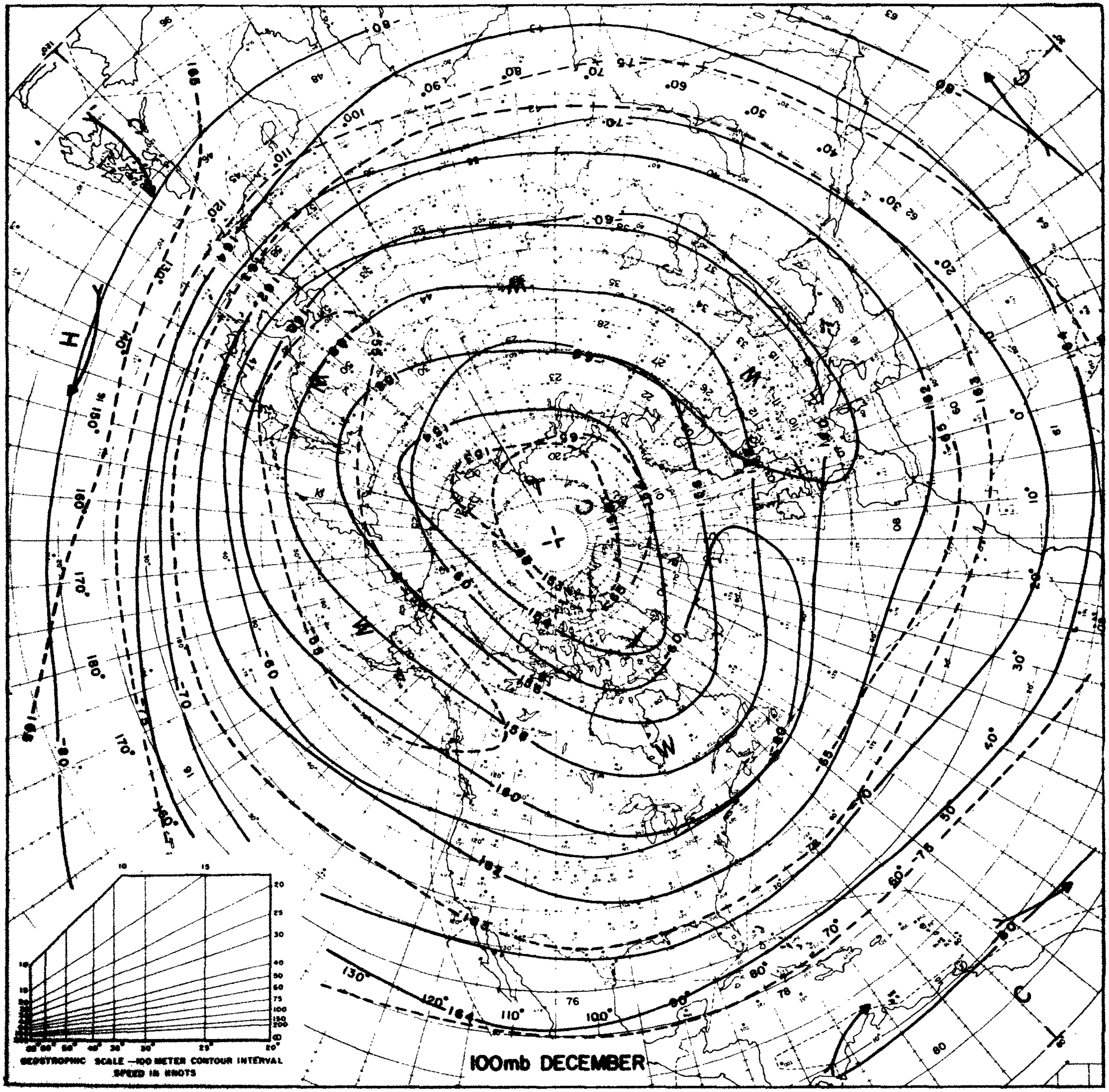

GEOSTROPHIC SCALE—100 METER CONTOUR INTERVAL
SPEED IN KNOTS
25 mb NOVEMBER

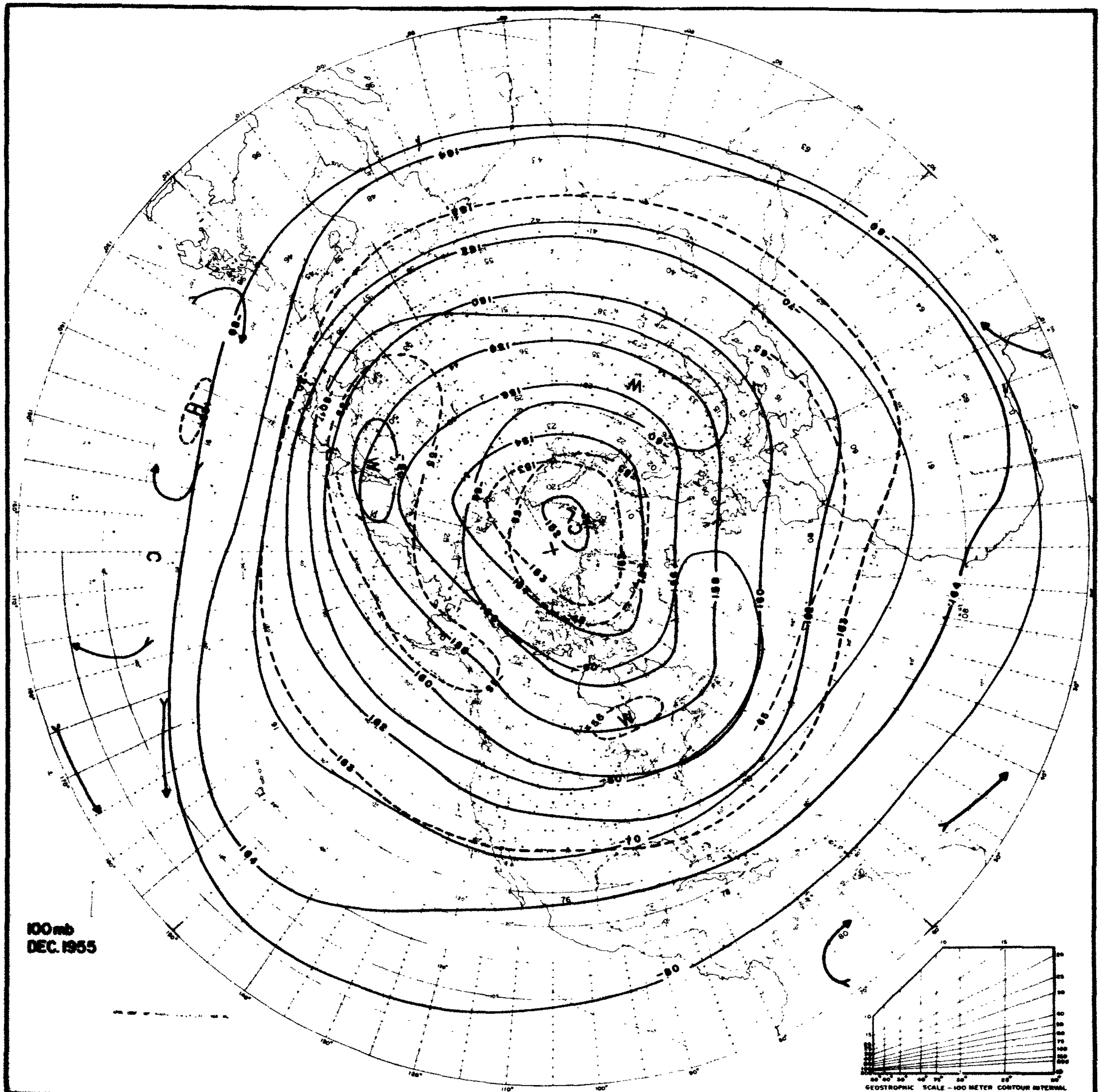


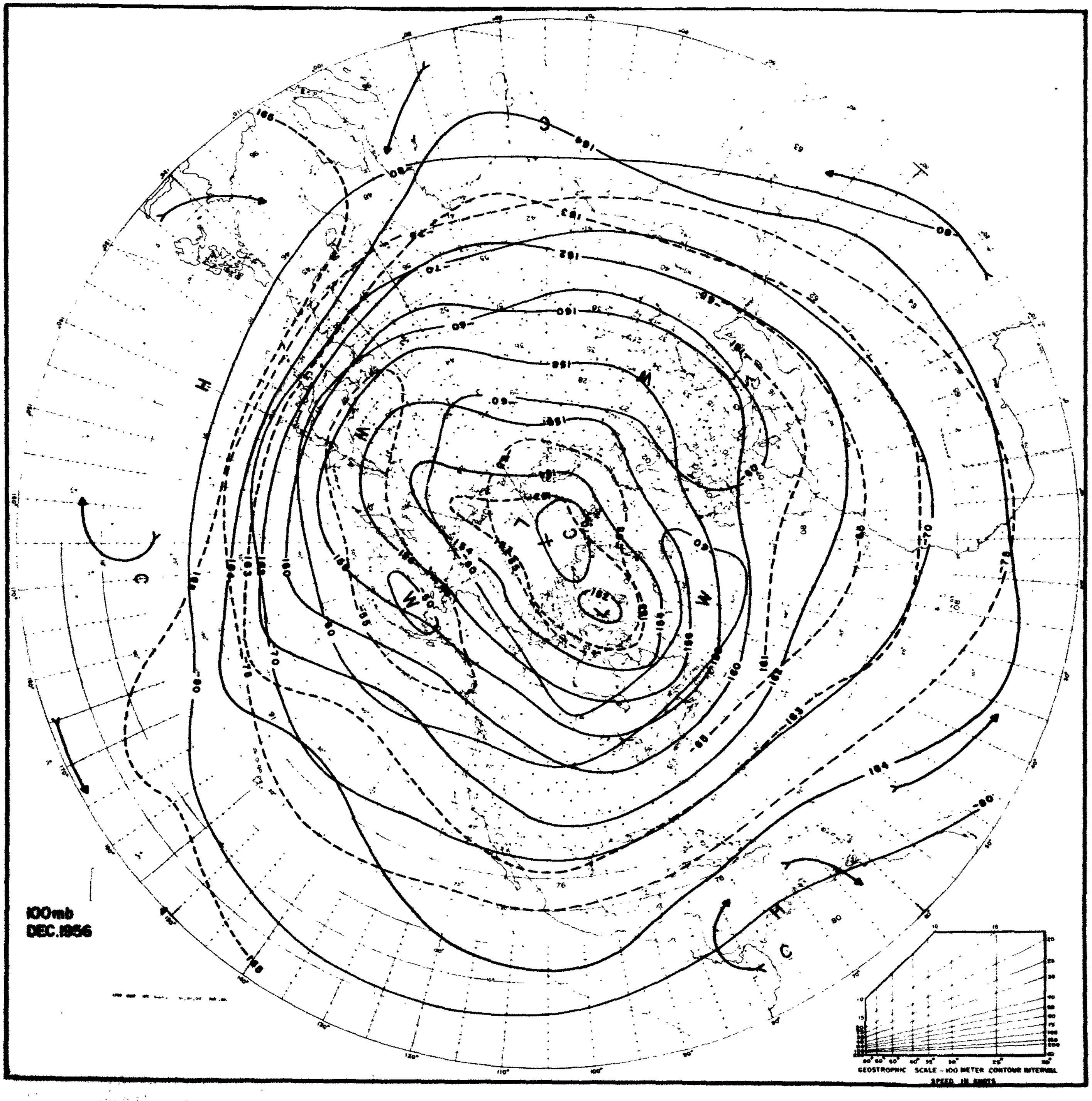
25 mb
NOV. 1956
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL


25 mb
NOV. 1958
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

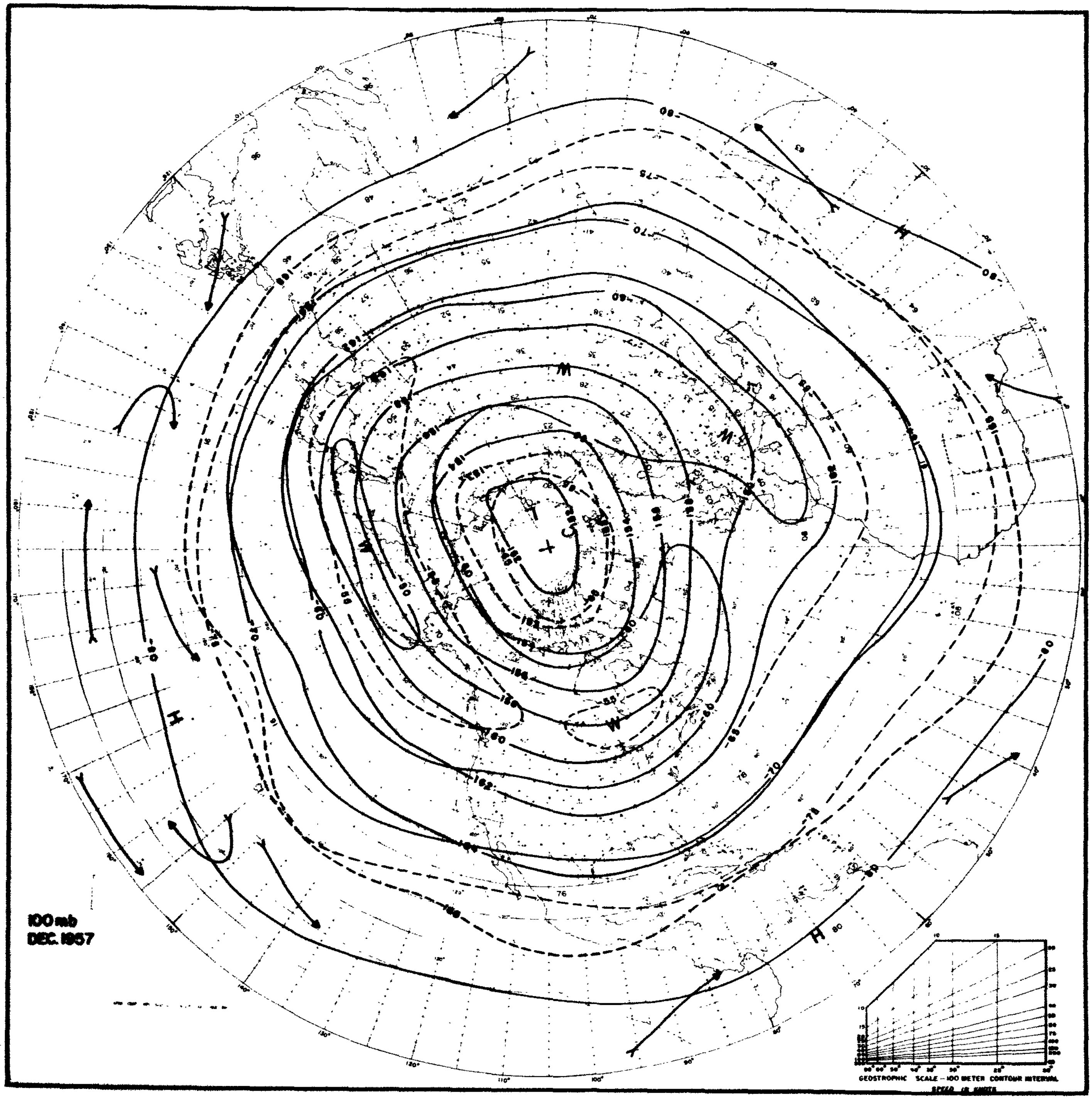


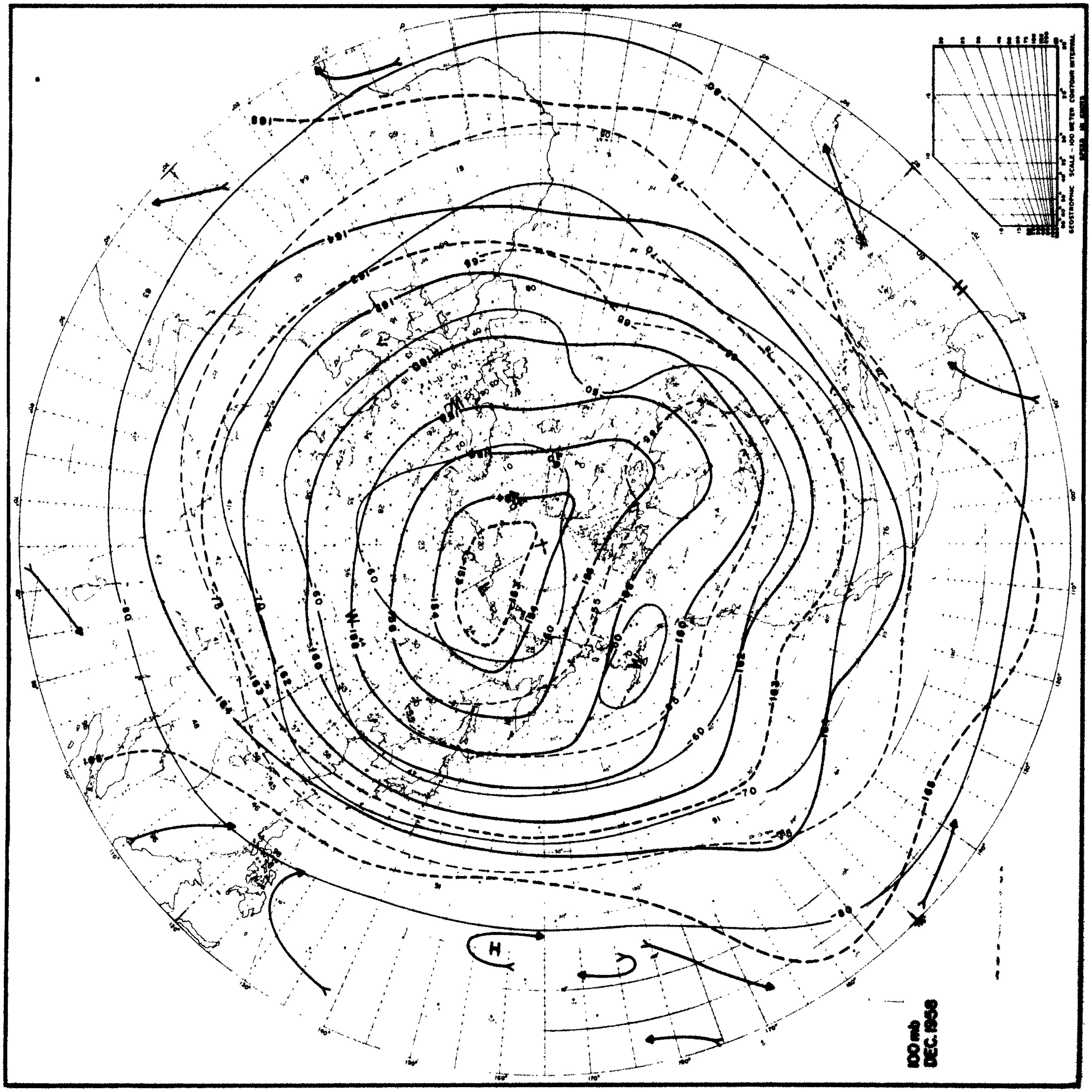

100mb DECEMBER
GEOSTROPHIC SCALE —100 METER CONTOUR INTERVAL
SPEED IN KNOTS

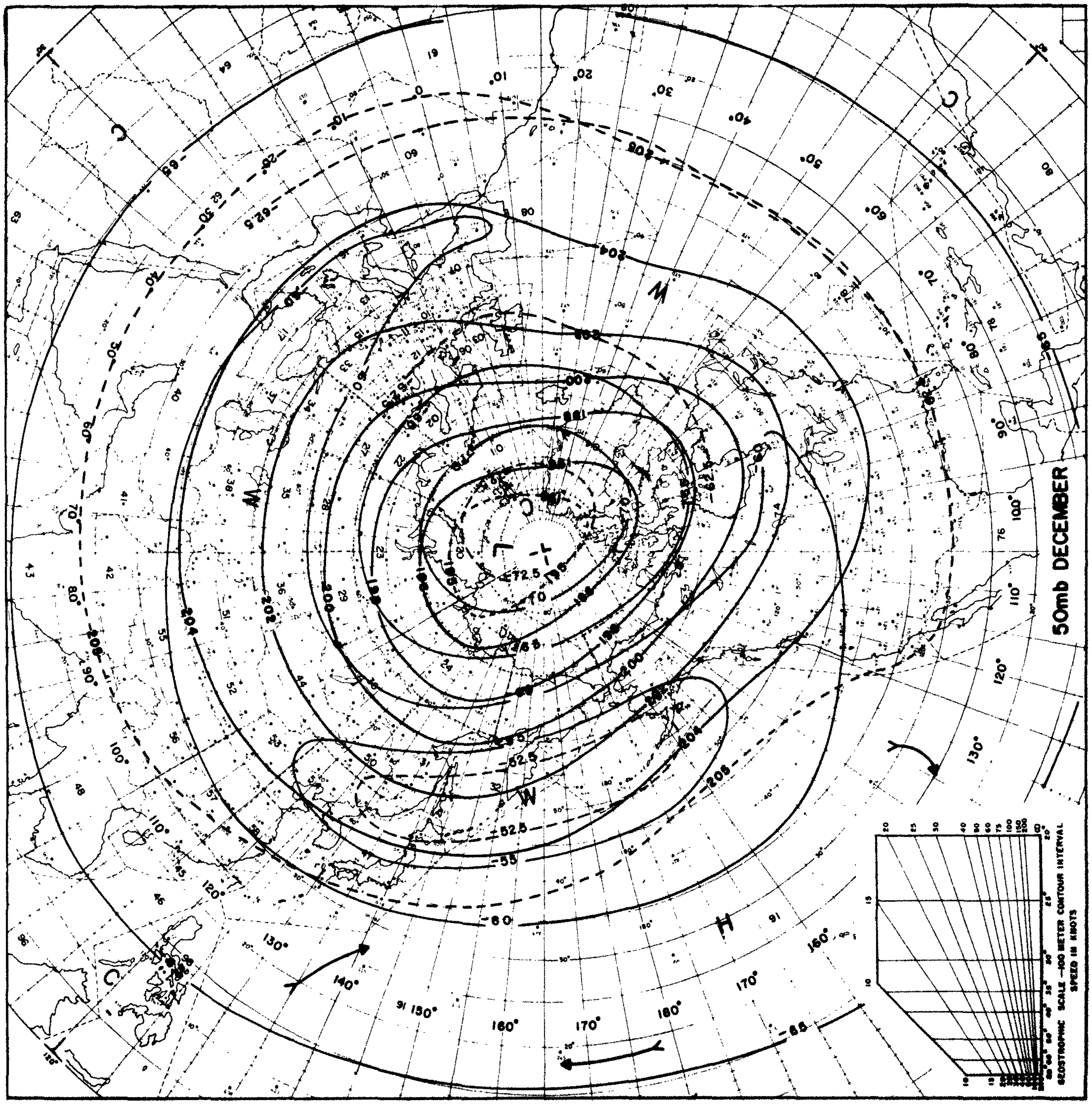

100 mb
DEC. 1955
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL

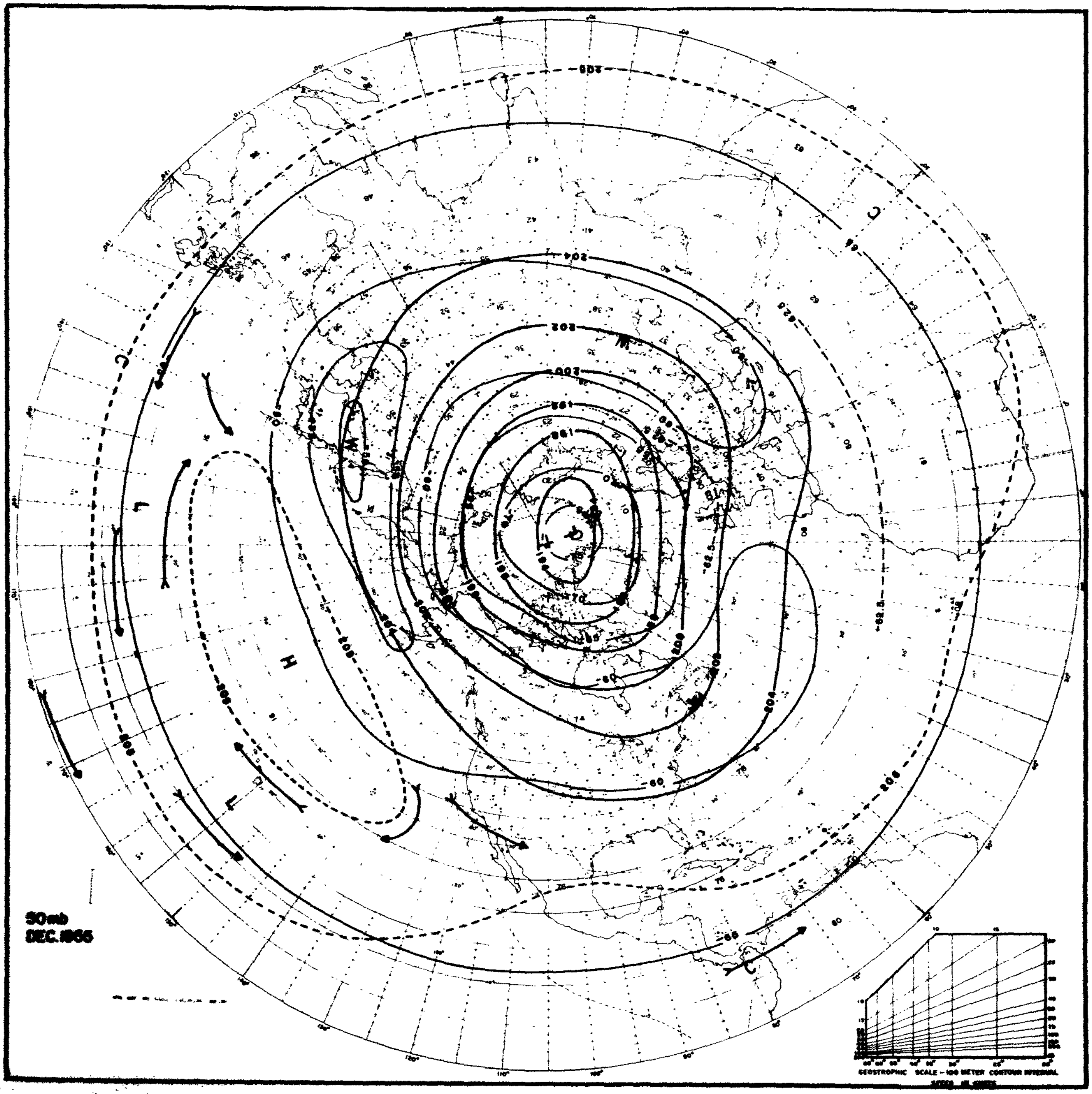


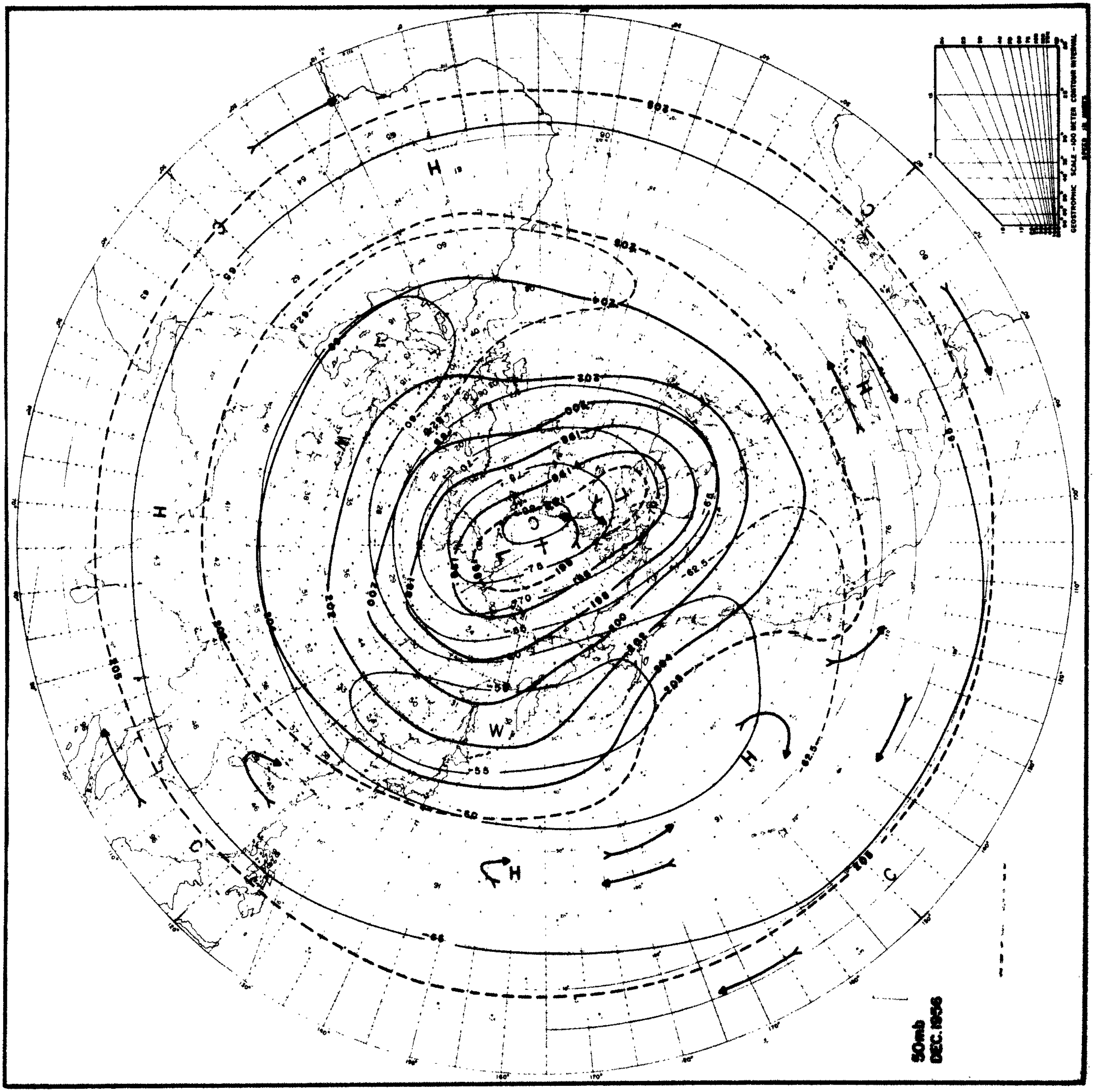
100mb
DEC. 1956
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

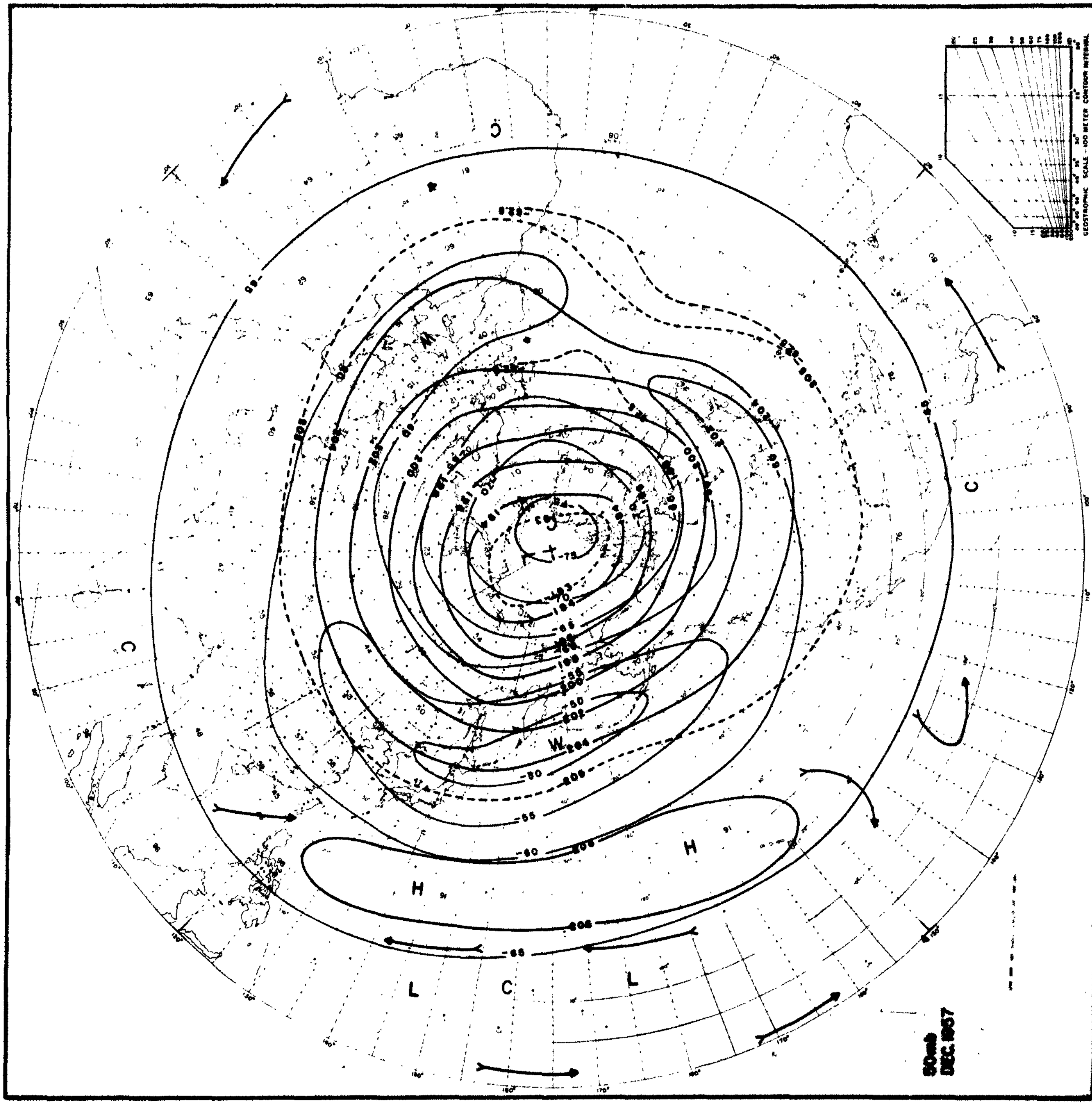

100 mb
DEC. 1957
GEOSTROPHIC SCALE – 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

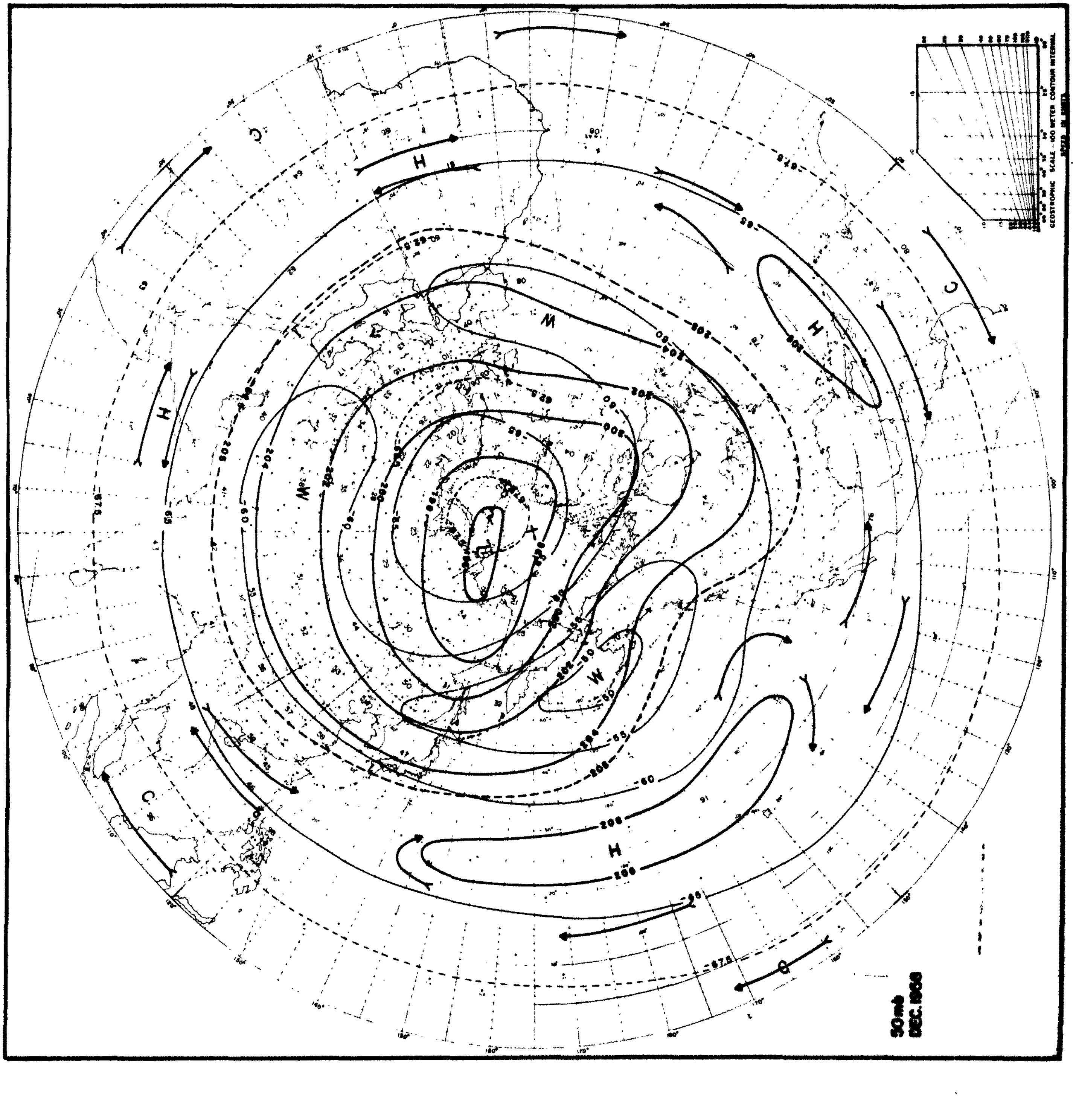

GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS
100 mb
DEC. 1958


50mb DECEMBER
GEOSTROPHIC SCALE —100 METER CONTOUR INTERVAL
SPEED IN KNOTS

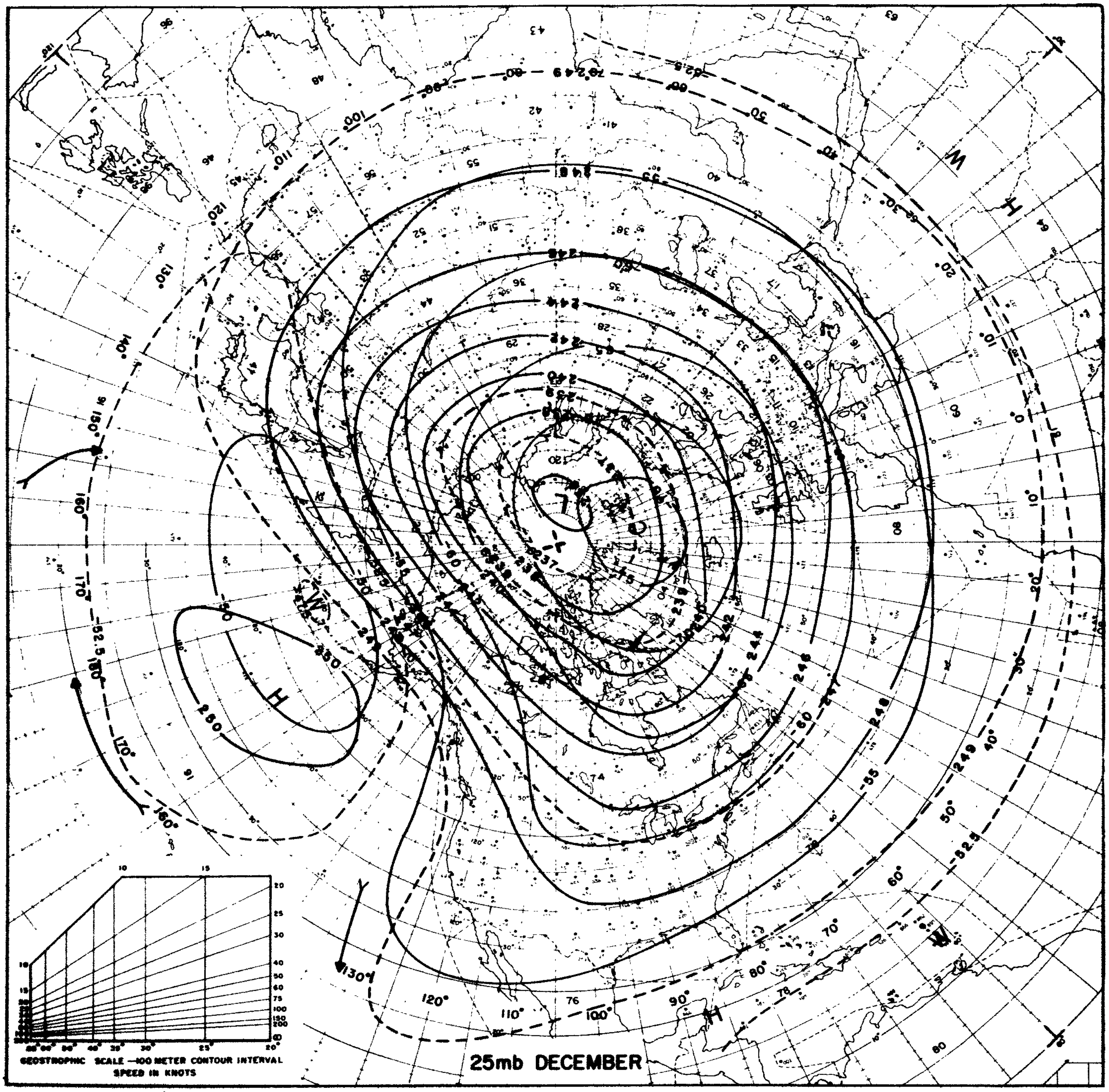

50mb
DEC. 1965
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS

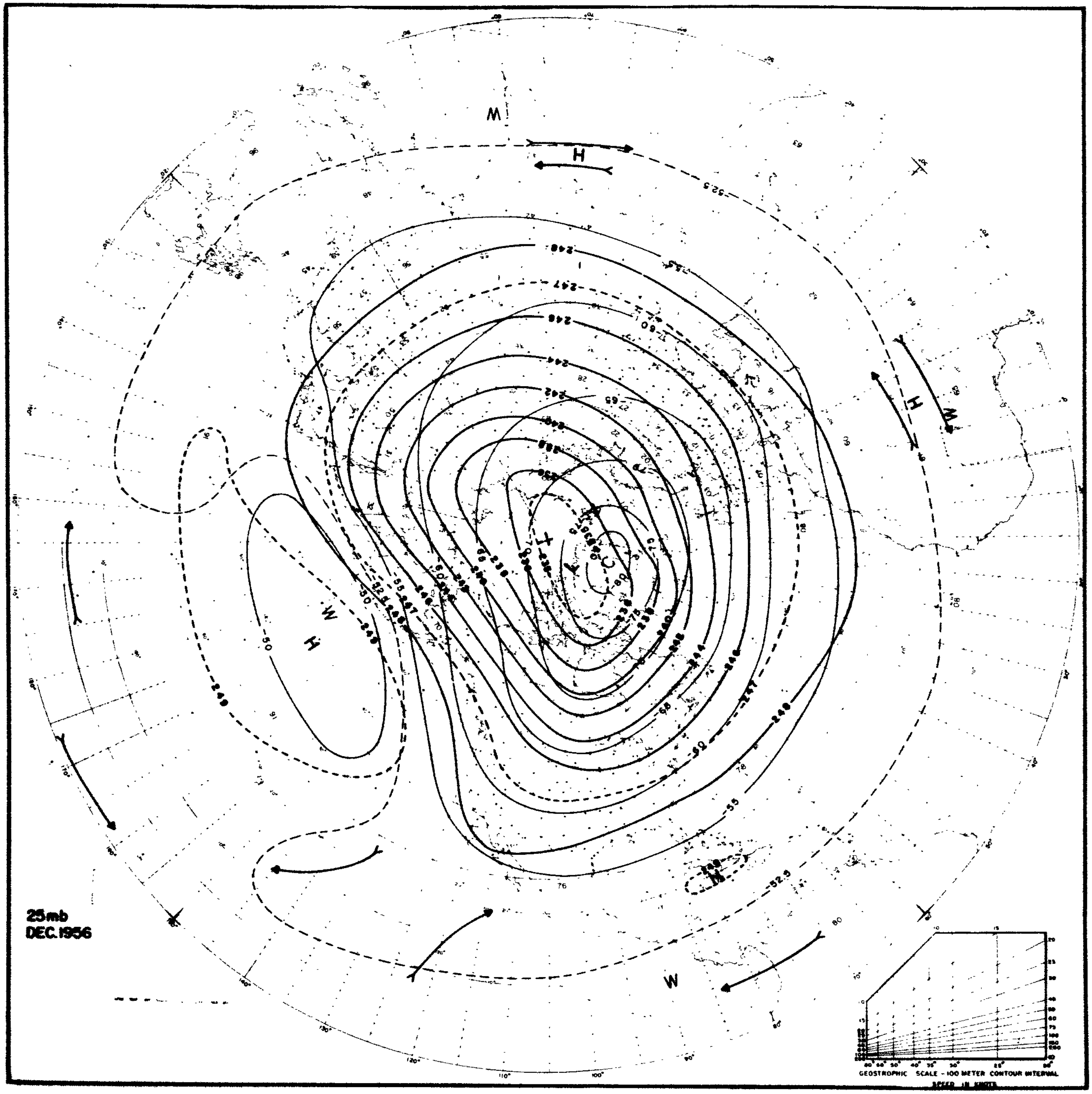

50mb
DEC. 1956

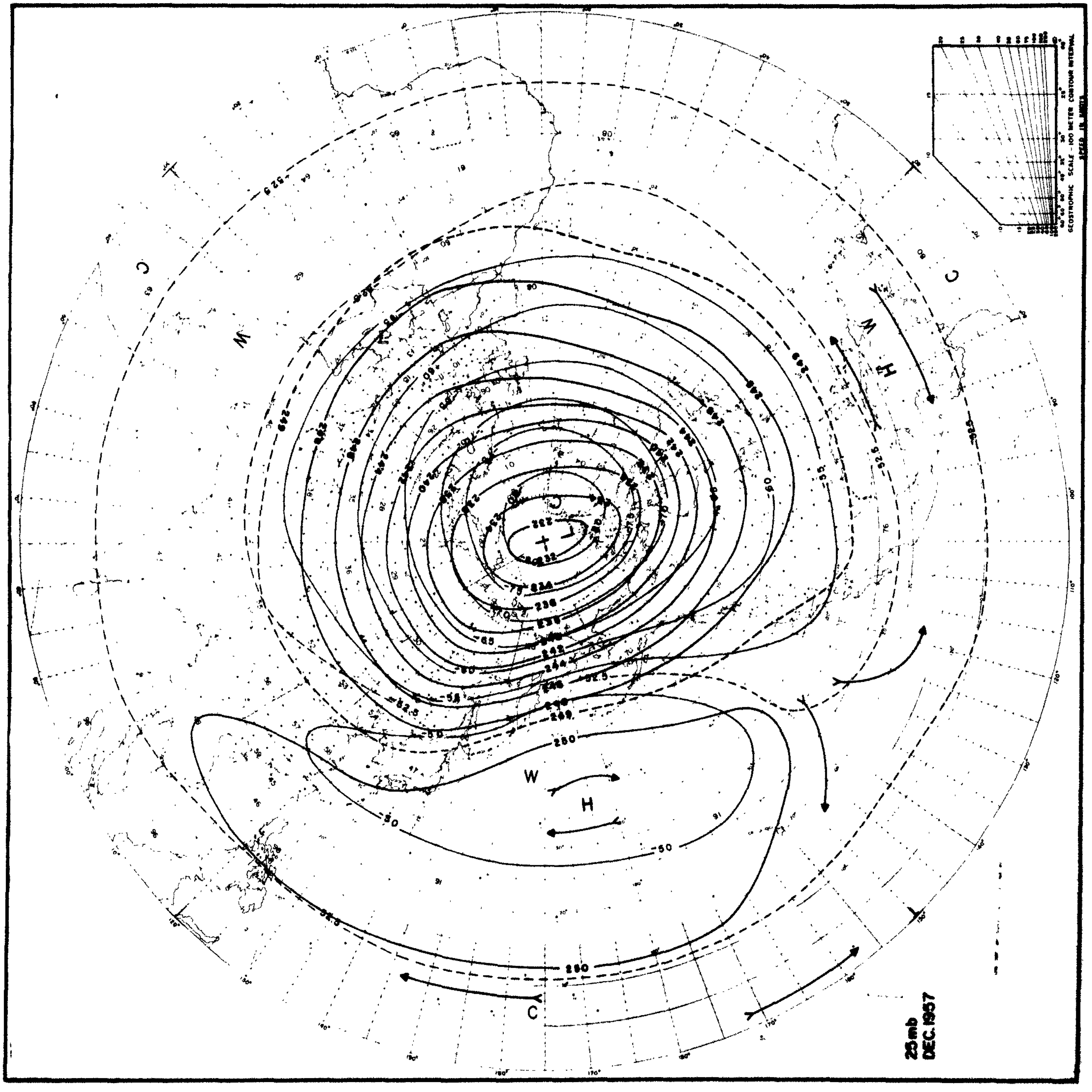

50mb
DEC. 1957
H
H
L
C
L
C
C
C
W
W

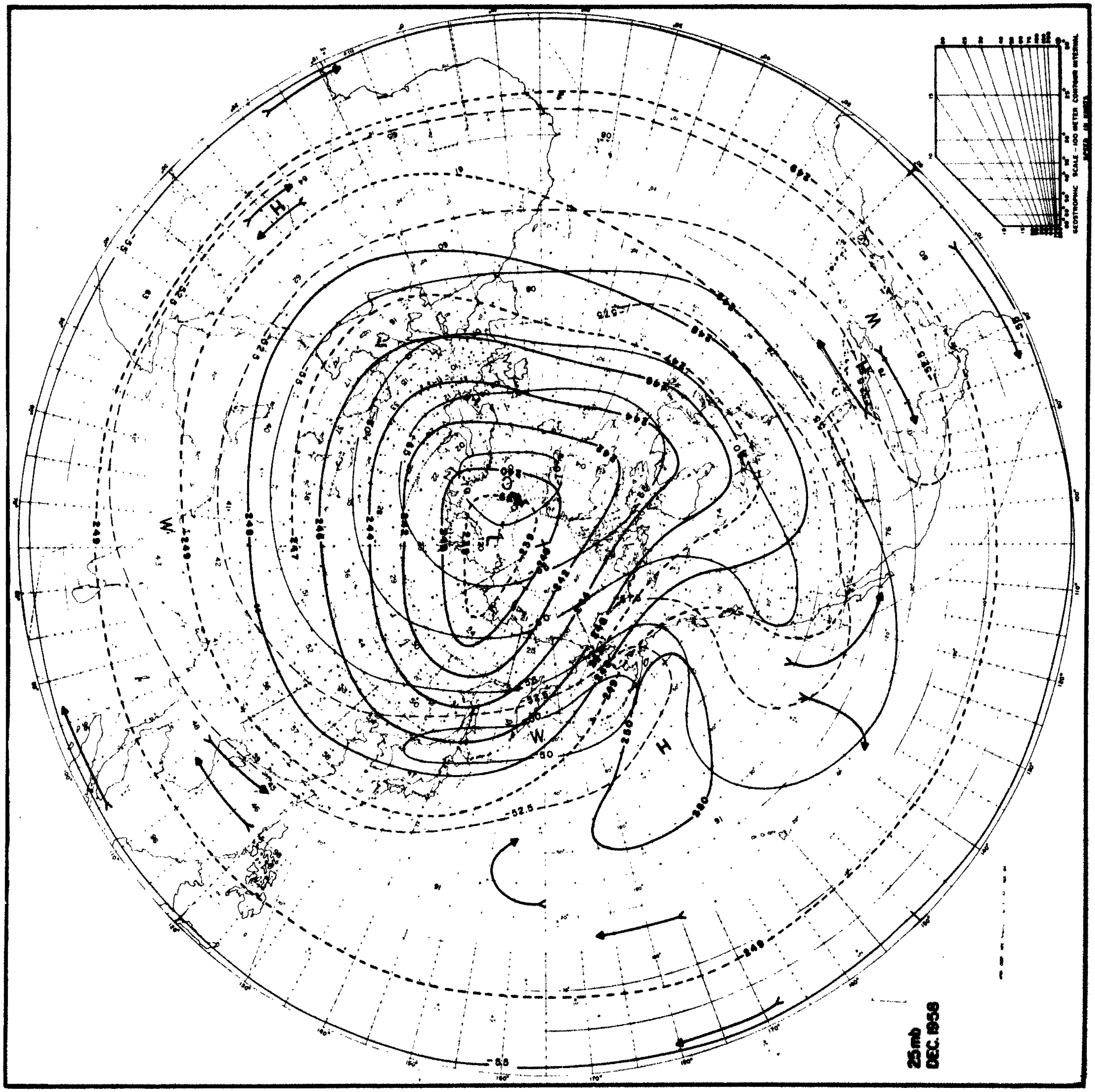


50 mb
DEC. 1966
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS


25mb DECEMBER
GEOSTROPHIC SCALE —100 METER CONTOUR INTERVAL
SPEED IN KNOTS


25mb
DEC. 1956
GEOSTROPHIC SCALE - 100 METER CONTOUR INTERVAL
SPEED IN KNOTS


25 mb
DEC. 1957
W
H
C


25mb
DEC. 1958

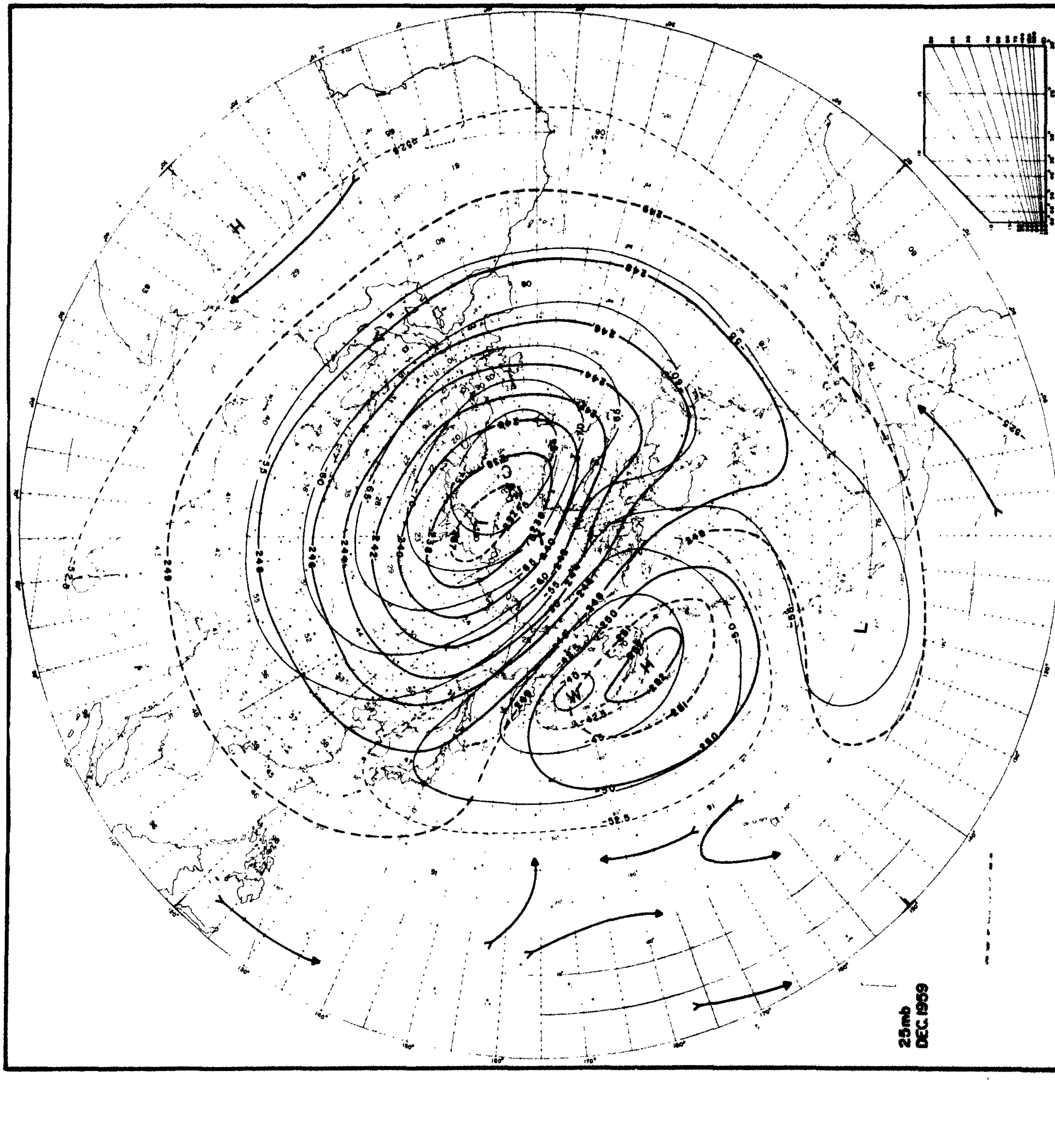

25mb
DEC 1959

Table 1A. Mean vector wind (10's of degrees, knots) in January

Latitude Degrees North	Longitude, Degrees											
				WEST						EAST		
	0	30	60	90	120	150	180	150	120	90	60	30
						100 mb						
	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV
20	2630	2630	2830	2620	2620	2925	2825	2720	2640	2630	2730	2760
30	2740	2630	2760	2760	2730	2840	2750	2780	2790	2760	2750	2750
40	2830	2740	2650	2750	2930	2730	2650	2660	2770	2950	2740	2730
50	2940	2650	2650	2850	2930	2620	2430	2440	2750	2940	2750	2840
60	2950	2650	2640	3040	3140	2720	2330	2240	2725	2940	2740	2830
70	2730	2530	2835	3240	3150	2740	2440	2230	2215	3030	2830	2825
80	2715	2710	3010	3215	3130	2740	2530	2230	1915	0000	3005	2915
						50 mb						
20	2905	2800	2700	2705	3005	0605	0604	2400	2610	2710	2610	2810
30	3015	2710	2720	2715	3205	0505	2300	2410	2625	2820	2620	2820
40	2905	2720	2640	2830	3220	3310	2310	2430	2640	2850	2630	2830
50	2640	2650	2760	2950	3230	2910	2320	2450	2660	2860	2750	2840
60	2760	2660	2750	2950	3150	2830	2440	2360	2650	2850	2750	2850
70	2740	2640	2730	3150	3160	2840	2560	2260	2225	2820	2830	2840
80	2715	2615	3320	3330	3150	2860	2550	2240	2120	2210	2710	2715
						25 mb						
20	0710	0810	0905	2210	0310	0915	0915	0910	2310	0000	0000	1005
30	3015	2705	2515	2515	3510	0610	0910	1405	2415	2705	2820	2620
40	2830	2725	2640	2740	3315	0405	1205	2205	2540	2740	2740	2740
50	2800	2670	2700	2860	3240	3210	2305	2230	2470	2870	2770	2860
60	2770	2680	2680	3060	3260	3040	2530	2270	2360	2760	2860	2860
70	2600	2550	2940	3170	3180	2980	2680	2380	2260	2640	2950	2860
80	2630	2815	3415	3450	3170	2980	2680	2370	2130	2120	2615	2625

Table 2A. Mean vector wind (10's degrees, knots) in April

Latitude Degrees North	Longitude, Degrees											
				WEST						EAST		
	0	30	60	90	120	150	180	150	120	90	60	30
						100 mb						
	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV
20	2640	2730	2830	2730	2630	2825	2925	2925	2525	2620	2630	2730
30	2740	2725	2840	2640	2730	2830	2840	2740	2750	2740	2740	2740
40	2825	2720	2730	2630	2825	2730	2740	2750	2760	2740	2725	2630
50	2910	2715	2615	2720	2815	2615	2620	2630	2830	2830	2720	2615
60	2910	2610	2410	2810	2810	2510	2310	2310	2910	3020	2820	2715
70	2915	2715	2410	3005	2910	2510	2210	1910	0000	3110	2915	2815
80	3210	2810	2705	2905	2710	2510	2110	1810	1305	0605	0210	3510
						50 mb						
20	2710	0000	0000	0905	2600	0000	0905	3105	2710	2705	2705	2805
30	2710	2705	2705	2705	2605	2805	0000	2810	2615	2810	2710	2810
40	2810	2805	2710	2810	2610	2710	2715	2620	2725	2920	2810	2515
50	3010	2805	2605	2805	2705	2505	2510	2415	2915	2915	2815	2510
60	3105	2905	2705	2805	2705	2505	2205	2215	2410	3015	2820	2705
70	3310	3005	2805	2705	2705	2405	2005	1810	1605	3205	3010	3010
80	0110	3405	3005	2805	2705	2405	2010	1710	1410	1005	0505	0310
						25 mb						
20	0905	0905	0905	0810	0905	1005	0905	0905	0910	0910	0915	0910
30	2605	2800	0000	0000	0000	1000	0900	2600	2810	2910	0000	0000
40	2710	3005	2605	2705	2805	2705	0000	2305	2610	2815	2815	2610
50	3105	3305	2605	2805	3000	3100	2200	2210	2510	2910	2810	2510
60	3605	3600	0000	0700	0705	0500	3005	1910	2310	2910	2710	2705
70	0110	0105	0605	0705	0705	0000	2005	1810	1610	0000	2000	3505
80	0210	0110	3405	3105	2705	2205	2010	1810	1510	1110	0810	0510

Table 3A. Mean vector wind (10's degrees, knots) in July

Latitude Degrees North	Longitude, Degrees											
				WEST						EAST		
	0	30	60	90	120	150	180	150	120	90	60	30
						100 mb						
	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV
20	1015	1005	0805	0815	1010	1405	1005	0715	0840	0940	0940	1030
30	2310	0000	0800	0710	1500	2505	0000	0615	0725	0910	0905	1905
40	2615	2705	2710	2915	2410	2410	2910	3115	2825	2730	2630	2620
50	2610	2715	2715	2915	2510	2410	2910	3010	2820	2720	2615	2615
60	[illegible]	2610	2810	3010	2610	2305	3105	2910	2710	2610	2705	2505
70	2105	1905	3300	3105	2705	2405	3005	2905	2705	2605	2905	2605
80	[illegible]	1705	0000	3200	2805	2705	2805	3005	3005	2905	2805	2505
						50 mb						
20	[illegible]	0930	0930	0930	0930	0930	0930	0940	0940	0930	0930	0930
30	[illegible]	0920	0920	0920	0920	0920	0920	0620	0920	0920	1020	0920
40	0910	0910	0810	0810	0910	1010	0910	0710	0910	1010	1010	0910
50	1005	1005	0805	0705	0905	1005	0905	0705	0905	1005	1005	1005
60	1005	1005	0805	0605	0905	1005	0905	0805	0905	1005	1005	1005
70	1005	1005	0905	0605	0805	1005	0905	0805	0905	1005	1005	1005
80	1105	1005	0905	0705	0605	0805	0905	0905	0905	1105	1105	1005
						25 mb						
20	[illegible]	0940	0940	0940	0940	0940	0940	0940	0940	0940	0940	0940
30	[illegible]	0930	0930	0930	0930	0930	0930	0930	0930	0930	0930	0930
40	[illegible]	0920	0920	0920	0920	0920	0920	0920	0920	0920	0920	0920
50	[illegible]	0915	0915	0915	0915	0915	0915	0915	0915	0915	0915	0915
60	[illegible]	0910	0910	0910	0910	0915	0910	0910	0910	0910	0910	0910
70	0910	0910	0910	0910	0910	0910	0910	0910	0910	0910	0910	0910
80	[illegible]	1005	1005	1005	0905	0905	0905	0905	0805	0805	0805	0905

Table 4A. Mean vector wind (10's of degrees, knots) in October

Latitude Degrees North	Longitude, Degrees											
				WEST						EAST		
	0	30	60	90	120	150	180	150	120	90	60	30
						100 mb						
	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV	DDVV
20	2720	2615	2915	2810	2610	2715	3410	0510	2415	2715	2705	2715
30	2720	2715	2715	2820	2615	2715	3115	2820	2640	2830	2725	2520
40	2820	2720	2730	2830	2725	2725	2930	2640	2750	2840	2830	2825
50	2820	2625	2730	2830	2725	2625	2840	2640	2730	2930	2830	2720
60	2820	2625	2620	2825	2725	2625	2730	2630	2820	2925	2825	[illegible]
70	2825	2625	2520	2920	2720	2520	2420	2320	2910	3015	2820	[illegible]
80	2815	2615	2515	2915	2715	2515	2310	2405	0000	3205	3110	2915
						50 mb						
20	0810	0915	0920	0920	0815	0915	0815	1015	1310	1210	0910	0705
30	2810	2705	2700	0000	0000	0000	0400	1100	2100	2615	2715	2710
40	2910	2710	2710	2710	2810	2710	2915	2615	2520	2725	2730	2815
50	2910	2615	2720	2815	2815	2620	2825	2625	2525	2825	2825	2815
60	2815	2620	2720	2820	2715	2615	2720	2625	2525	2825	2920	3020
70	2820	2620	2715	2820	2725	2625	2725	2625	2525	2815	3120	[illegible]
80	2820	2620	2715	2715	2520	2515	2610	2510	0000	3405	3210	[illegible]
						25 mb						
20	0920	0925	0925	0920	0920	0920	0920	0920	0915	0915	0915	[illegible]
30	0000	0900	0000	0000	0000	0905	0905	0605	2600	2710	2710	[illegible]
40	2810	2710	2715	2715	2910	2710	2610	2610	2615	2715	2820	2815
50	2915	2615	2620	2820	2915	2815	2715	2515	2520	2620	2820	[illegible]
60	2815	2620	2620	2820	2920	2820	2725	2620	2520	2620	2920	[illegible]
70	2820	2620	2520	2820	2825	2725	2625	2625	2520	2630	3020	[illegible]
80	2825	2625	2520	2715	2820	2720	2620	2620	2515	2405	3210	[illegible]

Table 1B. Mean height (10's of meters) in January

Latitude Degrees North	0	30	60	WEST 90	120	150	180	150	120	EAST 90	60	30
							Longitude, Degrees					
						100 mb						
	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	1643	1641	1644	1644	1641	1645	1652	1654	1649	1644	1643	1643
30	1625	1628	1632	1632	1628	1635	1638	1636	1625	1624	1625	1620
40	1609	1614	1606	1606	1613	1618	1609	1594	1584	1597	1605	1598
50	1592	1592	1582	1577	1597	1603	1590	1568	1550	1568	1580	1582
60	1563	1560	1540	1548	1577	1587	1577	1547	1527	1540	1550	1553
70	1533	1528	1519	1528	1551	1563	1554	1532	1514	1518	1526	1531
80	1511	1511	1512	1516	1524	1529	1526	1518	1509	1506	1508	1510
NORTH POLE							1508					
						50 mb						
20	2052	2054	2055	2055	2053	2055	2054	2056	2052	2053	2051	2051
30	2048	2052	2052	2050	2051	2057	2056	2052	2044	2047	2047	2044
40	2041	2044	2040	2040	2047	2059	2054	2043	2026	2035	2036	2032
50	2024	2024	2008	2017	2039	2052	2048	2024	1997	2003	2010	2012
60	1990	1983	1966	1979	2019	2040	2032	1994	1962	1964	1971	1982
70	1945	1939	1936	1950	1980	2000	1995	1965	1937	1934	1937	1944
80	1919	1918	1923	1931	1943	1952	1950	1938	1930	1921	1918	1919
NORTH POLE							1923					
						25 mb						
20	2489	2490	2491	2490	2489	2492	2492	2492	2490	2487	2491	2491
30	2489	2491	2488	2484	2488	2497	2496	2495	2485	2483	2485	2485
40	2482	2484	2476	2473	2485	2501	2500	2495	2475	2468	2470	2470
50	2454	2454	2437	2443	2473	2501	2502	2486	2443	2432	2438	2442
60	2412	2400	2383	2405	2448	2487	2492	2457	2398	2386	2393	2405
70	2357	2345	2339	2365	2408	2442	2444	2410	2365	2345	2350	2359
80	2323	2320	2328	2338	2360	2377	2377	2363	2342	2332	2327	2325
NORTH POLE							2332					

Table 2B. Mean height (10's of meters) in April

Latitude Degrees North	0	30	60	WEST 90	120	150	180	150	120	EAST 90	60	30
							Longitude, Degrees					
						100 mb						
	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	1648	1642	1646	1651	1645	1644	1651	1656	1658	1654	1652	1651
30	1632	1632	1634	1638	1633	1634	1641	1645	1642	1642	1637	1634
40	1616	1620	1619	1619	1618	1618	1617	1618	1612	1622	1622	1617
50	1607	1609	1605	1603	1607	1605	1599	1592	1590	1603	1609	1606
60	1601	1603	1597	1595	1598	1597	1591	1582	1577	1587	1595	1598
70	1591	1594	1591	1589	1592	1592	1586	1578	1572	1576	1582	1587
80	1583	1586	1585	1585	1586	1585	1583	1578	1575	1574	1577	1580
NORTH POLE							1581					
						50 mb						
20	2059	2058	2058	2059	2058	2059	2058	2059	2061	2061	2061	2061
30	2056	2056	2058	2059	2057	2058	2059	2057	2056	2057	2058	2058
40	2051	2053	2053	2054	2054	2053	2053	2052	2045	2051	2055	2053
50	2046	2049	2049	2049	2050	2049	2047	2040	2036	2042	2047	2046
60	2043	2047	2047	2047	2048	2047	2044	2037	2029	2033	2039	2041
70	2038	2043	2044	2044	2045	2044	2042	2035	2028	2028	2031	2035
80	2037	2040	2042	2042	2042	2042	2040	2035	2032	2029	2030	2033
NORTH POLE							2037					
						25 mb						
20	2496	2496	2496	2496	2496	2496	2496	2496	2496	2496	2497	2496
30	2496	2497	2497	2498	2497	2498	2497	2497	2496	2498	2502	2498
40	2491	2495	2496	2495	2496	2497	2497	2495	2491	2493	2496	2495
50	2486	2494	2494	2493	2494	2495	2497	2493	2486	2486	2489	2487
60	2484	2491	2493	2493	2494	2496	2496	2489	2482	2482	2483	2483
70	2485	2492	2495	2496	2497	2497	2495	2489	2481	2477	2478	2480
80	2487	2492	2496	2497	2497	2496	2493	2489	2485	2482	2482	2483
NORTH POLE							2492					

Table 3B. Mean height (10's of meters) in July

Latitude Degrees North	0	30	60	WEST 90	120	150	180	150	120	EAST 90	60	30
							Longitude, Degrees					
						100 mb						
	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	1659	1657	1656	1658	1658	1657	1653	1656	1662	1667	1667	1663
30	1663	1658	1658	1662	1662	1657	1656	1660	1673	1677	1676	1671
40	1657	1657	1656	1661	1659	1653	1653	1661	1671	1672	1671	1663
50	1650	1650	1647	1654	1655	1650	1648	1655	1658	1657	1655	1653
60	1646	1642	1640	1647	1649	1646	1645	1648	1650	1648	1648	1648
70	1643	1639	1638	1642	1644	1643	1642	1644	1645	1644	1645	1645
80	1642	1639	1637	1637	1639	1639	1639	1640	1642	1642	1643	1643
NORTH POLE							1639					
						50 mb						
20	2074	2074	2075	2077	2077	2077	2074	2074	2077	2077	2076	2075
30	2083	2083	2084	2086	2085	2084	2083	2084	2087	2087	2085	2083
40	2090	2090	2091	2093	2093	2091	2089	2092	2094	2093	2093	2091
50	2095	2094	2094	2096	2097	2096	2095	2096	2097	2097	2097	2096
60	2098	2097	2097	2098	2099	2099	2098	2099	2100	2099	2099	2098
70	2102	2101	2101	2102	2103	2103	2102	2103	2103	2103	2102	2102
80	2104	2104	2104	2105	2106	2107	2107	2107	2107	2107	2106	2105
NORTH POLE							2108					
						25 mb						
20	2518	2519	2518	2518	2518	2518	2518	2517	2517	2518	2518	2518
30	2531	2532	2533	2533	2533	2532	2531	2529	2529	2530	2531	2531
40	2542	2543	2544	2545	2544	2543	2543	2542	2543	2543	2543	2543
50	2552	2552	2553	2554	2554	2553	2553	2553	2553	2553	2553	2552
60	2562	2562	2562	2563	2563	2563	2563	2562	2563	2563	2563	2562
70	2570	2572	2572	2571	2571	2571	2570	2570	2571	2571	2571	2571
80	2577	2577	2577	2576	2576	2576	2576	2576	2576	2576	2576	2577
NORTH POLE							2578					

Table 4B. Mean height (10's of meters) in October

Latitude Degrees North	0	30	60	WEST 90	120	150	180	150	120	EAST 90	60	30
							Longitude, Degrees					
						100 mb						
	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
20	1648	1647	1647	1651	1651	1650	1653	1658	1657	1654	1656	1652
30	1642	1643	1643	1646	1645	1643	1651	1658	1648	1646	1649	1644
40	1633	1637	1635	1635	1636	1634	1642	1642	1625	1628	1635	1633
50	1623	1624	1616	1618	1621	1619	1619	1613	1601	1608	1617	1625
60	1608	1609	1598	1601	1604	1601	1597	1590	1582	1590	1599	1603
70	1592	1592	1584	1585	1588	1585	1579	1573	1570	1576	1582	1587
80	1577	1576	1573	1573	1573	1571	1568	1566	1563	1567	1571	1575
NORTH POLE							1566					
						50 mb						
20	2068	2067	2067	2067	2067	2067	2069	2069	2068	2066	2067	2070
30	2066	2068	2070	2069	2069	2069	2073	2074	2067	2065	2065	2065
40	2062	2065	2065	2065	2067	2067	2069	2070	2060	2056	2059	2050
50	2057	2060	2056	2055	2059	2057	2057	2056	2045	2042	2047	2052
60	2050	2049	2043	2044	2048	2044	2043	2042	2030	2025	2032	2042
70	2036	2036	2030	2032	2032	2028	2024	2022	2013	2010	2017	2028
80	2018	2019	2017	2017	2015	2011	2009	2007	2004	2006	2009	2014
NORTH POLE							2008					
						25 mb						
20	2506	2505	2505	2506	2506	2506	2505	2505	2505	2504	2505	2506
30	2509	2509	2509	2509	2511	2511	2511	2510	2509	2507	2505	2506
40	2507	2508	2506	2506	2508	2509	2509	2508	2503	2499	2499	2503
50	2499	2502	2497	2496	2500	2504	2504	2501	2493	2487	2487	2493
60	2488	2490	2482	2482	2487	2492	2490	2487	2481	2476	2474	2482
70	2477	2477	2469	2467	2471	2474	2472	2470	2434	2460	2460	2469
80	2458	2458	2455	2452	2453	2454	2453	2451	2449	2446	2448	2454
NORTH POLE							2446					

Table 1C. Mean temperature (°C) in January

Latitude Degrees North	0	30	60	WEST 90	120	150	180	150	120	EAST 90	60	30
							100 mb					
20	-73	-72	-74	-74	-72	-74	-78	-80	-77	-75	-74	-73
30	-67	-67	-68	-69	-67	-68	-69	-71	-68	-67	-67	-67
40	-60	-62	-60	-60	-59	-60	-58	-56	-56	-58	-59	-59
50	-58	-61	-58	-58	-55	-53	-52	-49	-55	-59	-59	-58
60	-62	-63	-63	-60	-56	-53	-51	-54	-62	-64	-64	-63
70	-66	-66	-66	-63	-59	-57	-57	-61	-66	-68	-68	-67
80	-69	-68	-67	-66	-64	-63	-64	-66	-68	-70	-72	-71
NORTH POLE							-68					
							50 mb					
20	-64	-64	-64	-64	-63	-64	-65	-65	-63	-65	-65	-64
30	-62	-62	-62	-62	-61	-61	-62	-61	-60	-61	-62	-62
40	-59	-59	-60	-60	-59	-58	-56	-54	-54	-58	-58	-58
50	-60	-60	-61	-59	-57	-54	-50	-48	-58	-62	-61	-59
60	-65	-67	-67	-63	-58	-53	-50	-55	-64	-67	-66	-65
70	-72	-73	-72	-68	-63	-58	-58	-62	-68	-72	-72	-71
80	-76	-76	-74	-72	-68	-67	-67	-68	-71	-73	-75	-76
NORTH POLE							-74					
							25 mb					
20	-53	-53	-53	-54	-56	-53	-55	-55	-53	-53	-53	-53
30	-54	-54	-54	-55	-57	-53	-53	-52	-52	-54	-54	-54
40	-55	-55	-57	-58	-58	-53	-51	-50	-51	-55	-57	-57
50	-58	-59	-63	-62	-59	-53	-49	-48	-55	-58	-59	-61
60	-66	-67	-68	-67	-63	-54	-50	-50	-59	-64	-65	-67
70	-71	-72	-72	-71	-66	-61	-56	-58	-65	-69	-71	-72
80	-74	-74	-74	-72	-70	-67	-67	-67	-69	-72	-74	-74
NORTH POLE							-73					

Table 2C. Mean temperature (°C) in April

Latitude Degrees North	0	30	60	WEST 90	120	150	180	150	120	EAST 90	60	30
							100 mb					
20	-74	-71	-73	-74	-73	-73	-75	-77	-77	-75	-75	-76
30	-66	-66	-67	-69	-67	-68	-70	-71	-70	-69	-68	-67
40	-59	-60	-59	-59	-59	-60	-60	-61	-58	-59	-59	-59
50	-57	-56	-54	-54	-56	-55	-54	-53	-53	-56	-57	-57
60	-54	-52	-50	-50	-52	-52	-50	-49	-49	-52	-54	-54
70	-51	-50	-49	-49	-49	-49	-48	-48	-48	-49	-51	-52
80	-49	-49	-48	-48	-47	-47	-47	-47	-47	-48	-49	-49
NORTH POLE							-48					
							50 mb					
20	-64	-63	-63	-63	-63	-62	-64	-66	-66	-66	-66	-65
30	-61	-61	-61	-61	-61	-61	-62	-62	-61	-62	-63	-62
40	-58	-58	-58	-57	-57	-58	-58	-57	-56	-58	-60	-59
50	-56	-56	-55	-54	-55	-55	-54	-53	-53	-55	-57	-56
60	-54	-54	-53	-53	-53	-52	-50	-49	-51	-53	-54	-54
70	-53	-53	-52	-51	-51	-50	-48	-47	-50	-52	-53	-53
80	-52	-51	-50	-49	-49	-48	-48	-49	-50	-51	-52	-52
NORTH POLE							-50					
							25 mb					
20	-52	-52	-53	-52	-52	-52	-52	-52	-52	-52	-52	-52
30	-53	-53	-53	-53	-53	-53	-52	-52	-52	-53	-53	-53
40	-53	-53	-54	-53	-53	-54	-53	-52	-52	-53	-54	-53
50	-54	-54	-54	-53	-53	-53	-53	-51	-51	-53	-54	-54
60	-53	-53	-53	-53	-53	-52	-52	-49	-50	-52	-53	-53
70	-53	-53	-52	-52	-52	-51	-50	-48	-49	-51	-52	-53
80	-52	-52	-52	-51	-51	-50	-49	-49	-50	-51	-51	-52
NORTH POLE							-51					

Table 3C. Mean temperature (°C) in July

Latitude Degrees North	0	30	60	WEST 90	120	150	180	150	120	EAST 90	60	30
							100 mb					
20	-76	-73	-72	-73	-73	-72	-71	-73	-77	-78	-78	-77
30	-71	-68	-66	-69	-69	-65	-64	-70	-75	-76	-76	-75
40	-62	-62	-62	-63	-63	-58	-58	-63	-69	-70	-69	-65
50	-55	-55	-53	-57	-57	-54	-54	-57	-59	-58	-58	-57
60	-50	-48	-48	-49	-51	-49	-49	-52	-53	-53	-52	-51
70	-46	-45	-44	-45	-46	-46	-46	-47	-48	-48	-48	-47
80	-43	-42	-42	-42	-43	-43	-43	-44	-44	-45	-45	-44
NORTH POLE							-42					
							50 mb					
20	-62	-62	-61	-61	-61	-61	-61	-62	-63	-63	-62	-62
30	-59	-59	-58	-58	-58	-58	-58	-59	-61	-61	-61	-60
40	-56	-55	-55	-55	-56	-55	-55	-55	-57	-57	-56	-56
50	-52	-52	-51	-52	-52	-51	-52	-52	-52	-51	-51	-52
60	-48	-48	-47	-48	-48	-48	-48	-48	-48	-47	-47	-48
70	-44	-44	-44	-45	-45	-45	-46	-46	-46	-45	-44	-44
80	-42	-41	-42	-43	-43	-43	-43	-43	-43	-43	-43	-42
NORTH POLE							-43					
							25 mb					
20	-51	-51	-51	-51	-51	-51	-52	-52	-52	-52	-51	-51
30	-50	-50	-50	-50	-50	-50	-51	-51	-51	-51	-50	-50
40	-48	-48	-48	-48	-48	-48	-49	-49	-49	-49	-48	-48
50	-46	-46	-46	-46	-46	-46	-47	-47	-47	-46	-46	-46
60	-44	-44	-44	-44	-44	-44	-44	-44	-44	-44	-44	-44
70	-42	-42	-42	-42	-42	-42	-42	-42	-42	-42	-42	-42
80	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
NORTH POLE							-39					

Table 4C. Mean temperature (°C) in October

Latitude Degrees North	0	30	60	WEST 90	120	150	180	150	120	EAST 90	60	30
							100 mb					
20	-72	-72	-74	-76	-75	-73	-75	-77	-77	-74	-74	-73
30	-67	-68	-69	-71	-70	-68	-71	-73	-71	-69	-69	-68
40	-64	-64	-63	-64	-63	-62	-64	-64	-61	-62	-62	-63
50	-61	-61	-58	-58	-57	-55	-57	-55	-54	-57	-57	-58
60	-57	-56	-54	-54	-54	-51	-50	-51	-53	-54	-54	-56
70	-54	-54	-53	-53	-52	-51	-51	-51	-52	-53	-53	-54
80	-53	-53	-53	-53	-52	-52	-52	-52	-52	-53	-53	-53
NORTH POLE							-53					
							50 mb					
20	-61	-62	-62	-62	-62	-62	-63	-63	-62	-62	-62	-62
30	-60	-60	-60	-60	-61	-61	-61	-61	-60	-60	-60	-60
40	-59	-59	-58	-59	-59	-58	-59	-58	-56	-57	-58	-59
50	-58	-58	-57	-57	-57	-55	-55	-54	-54	-56	-58	-58
60	-56	-57	-57	-56	-55	-53	-52	-52	-54	-55	-57	-58
70	-57	-57	-57	-56	-56	-54	-54	-54	-55	-56	-56	-57
80	-58	-58	-57	-57	-57	-56	-56	-56	-56	-57	-57	-58
NORTH POLE							-58					
							25 mb					
20	-51	-51	-51	-51	-53	-52	-52	-52	-52	-52	-53	-52
30	-52	-52	-52	-52	-54	-52	-51	-51	-52	-53	-54	-53
40	-54	-53	-53	-54	-55	-53	-52	-52	-53	-54	-55	-54
50	-56	-55	-54	-56	-56	-54	-52	-53	-54	-56	-57	-57
60	-59	-58	-57	-58	-58	-55	-54	-55	-57	-58	-59	-60
70	-61	-60	-59	-56	-59	-58	-58	-59	-59	-60	-61	-62
80	-62	-62	-61	-61	-61	-61	-61	-61	-61	-62	-62	-63
NORTH POLE							-62					